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# STAR

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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *34 Fluid Mechanics and Heat Transfer.*

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## ASTRONAUTICS

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**55 SPACE BIOLOGY** **N.A.**

Includes exobiology; planetary biology; and extraterrestrial life.

## MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

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Includes feedback and control theory, artificial intelligence, robotics and expert systems.

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Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

**70 PHYSICS (GENERAL)** **N.A.**

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

**71 ACOUSTICS** 1542
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

**72 ATOMIC AND MOLECULAR PHYSICS** 1543
Includes atomic structure, electron properties, and molecular spectra.

**73 NUCLEAR AND HIGH-ENERGY PHYSICS** 1545
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

**74 OPTICS** 1548
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

**75 PLASMA PHYSICS** 1551
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

**76 SOLID-STATE PHYSICS** 1554
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**77 THERMODYNAMICS AND STATISTICAL PHYSICS** 1562
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

## SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

**80 SOCIAL SCIENCES (GENERAL)** N.A.
Includes educational matters.

**81 ADMINISTRATION AND MANAGEMENT** 1564
Includes management planning and research.

**82 DOCUMENTATION AND INFORMATION SCIENCE** 1564
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

**83 ECONOMICS AND COST ANALYSIS** 1566
Includes cost effectiveness studies.

**84 LAW, POLITICAL SCIENCE AND SPACE POLICY** 1566
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**85 URBAN TECHNOLOGY AND TRANSPORTATION** 1566
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

## SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

**88 SPACE SCIENCES (GENERAL)** N.A.

**89 ASTRONOMY** 1568
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

**90 ASTROPHYSICS** 1568
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

**91 LUNAR AND PLANETARY EXPLORATION** 1570
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**92 SOLAR PHYSICS** 1571
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

**93 SPACE RADIATION** 1571
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

## GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

**99 GENERAL** N.A.

**Note: N.A. means that no abstracts were assigned to this category for this issue.**

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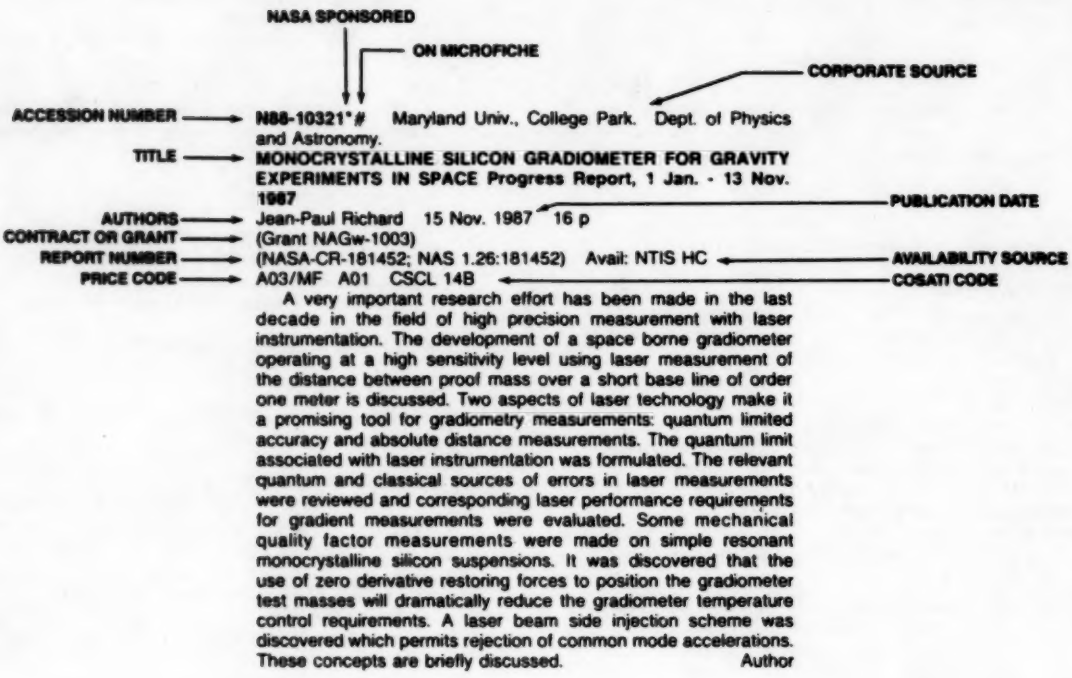
# TYPICAL CITATION AND ABSTRACT


NASA SPONSORED
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ACCESSION NUMBER
N86-10321*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
TITLE
MONOCRYSTALLINE SILICON GRADIOMETER FOR GRAVITY EXPERIMENTS IN SPACE Progress Report, 1 Jan. - 13 Nov. 1987
PUBLICATION DATE
AUTHORS
Jean-Paul Richard 15 Nov. 1987 16 p
CONTRACT OR GRANT
(Grant NAGw-1003)
REPORT NUMBER
(NASA-CR-181452; NAS 1.26:181452) Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A03/MF A01 CSCL 14B
COSATI CODE
A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 11 / JUNE 8, 1988

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERONAUTICS (GENERAL)

**N88-18549#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1987-1, 236/JANUARY-FEBRUARY**
Claude Sevestre ESA Jul. 1987 81 p Transl. into ENGLISH of La Recherche Aerospatiale: Bimonthly Bulletin, Number 1987-1, 236/January-February
(ESA-TT-1055; ETN-88-91122) Avail: NTIS HC A05/MF A01

Computation of the pressure in the spectral approximation of the Stokes problem; optical ablation/temperature gage; homogenization at set macroscopic stress: numerical implementation and application; an aerodynamic study of a helicopter rotor in hovering flight; and numerical simulation of turbulent flow are discussed. ESA

**N88-18550#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1987-2, 237/MARCH-APRIL**
Claude Sevestre Paris, France ESA Sep. 1987 62 p Transl. into ENGLISH of La Recherche Aerospatiale: Bimonthly Bulletin, Number 1987-2, 237/March-April
(ESA-TT-1074; ETN-88-91132) Avail: NTIS HC A04/MF A01

An unsteady test method applied to wind tunnel studies of flutter; simultaneous active controls on a wind tunnel model; icing and deicing on a downscale model in a wind tunnel; a differential damage rule with microinitiation and micropropagation; simulation of unsteady flows at high Reynolds numbers on an experimental multiprocessor system; and characterization of Meteosat nutation dampers are discussed. ESA

**N88-18551#** General Accounting Office, Washington, D. C. National Security and International Affairs Div.
**ARMY MAINTENANCE: ACTIONS TO REDUCE THE LIKELIHOOD OF HELICOPTER GEAR FAILURES**
Jun. 1987 25 p
(PB88-135256; GAO/NSIAD-87-160; B-226908) Avail: NTIS HC A03/MF A01 CSCL 01C

The Army's actions to address problems with the helical torquemeter gear on OH-6A and OH-58A observation helicopters are reviewed. The gear is contained in the accessory gearbox of the T63-A-700 engine, which, as of August 1986, was installed in 370 OH-6A and 1,365 OH-58A helicopters. These helicopters are used by both active and reserve forces at U.S. and overseas locations. Author

## 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N88-18552*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**A PERFORMANCE INDEX APPROACH TO AERODYNAMIC DESIGN WITH THE USE OF ANALYSIS CODES ONLY**
Raymond L. Barger and Anutosh Moitra (High Technology Corp., Hampton, Va.) Mar. 1988 21 p
(NASA-TP-2805; L-16379; NAS 1.60:2805) Avail: NTIS HC A03/MF A01 CSCL 01A

A method is described for designing an aerodynamic configuration for a specified performance vector, based on results from several similar, but not identical, trial configurations, each defined by a geometry parameter vector. The theory shows the method effective provided that: (1) the results for the trial configuration provide sufficient variation so that a linear combination of them approximates the specified performance; and (2) the difference between the performance vectors (including the specified performance) are sufficiently small that the linearity assumption of sensitivity analysis applies to the differences. A computed example describes the design of a high supersonic Mach number missile wing body configuration based on results from a set of four trial configurations. Author

**N88-18553#** Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
**THE AERODYNAMIC DESIGN OPTIMISATION OF A FORWARD SWEPT WING FIGHTER AIRCRAFT**
M. V. Cobk and F. Heydari Sep. 1987 45 p
(CAR-8716; ISBN-0-947767-83-5) Avail: NTIS HC A03/MF A01

Research has been conducted, the principal objective of which was to study the stability and control characteristics of a combat aircraft with a forward swept wing (FSW). Prior to the commencement of the main study, it was necessary to design a notional aircraft in sufficient detail to provide a viable basis for the stability studies. In particular, it was essential to provide adequate geometric and aerodynamic detail for the aircraft design. The initial design work led to the definition of a single engine FSW fighter configuration. Subsequently, the design was revised to incorporate significantly more aerodynamic detail, leading to the aircraft design used in the stability studies. FSW aircraft design optimization studies are summarized. Author

**N88-18554#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**MEASUREMENT OF FORCES AND MOMENTS ON, AND VELOCITY ABOUT A BODY OF REVOLUTION WITH AN ATTACHED FIN AT ANGLES OF ATTACK M.S. Thesis**
Jeffrey S. Reed Jun. 1987 88 p
(Contract N00228-85-G-3262)
(AD-A187796) Avail: NTIS HC A05/MF A01 CSCL 20D

The body of revolution had a length to diameter ratio of 9.5 and was tested with a square tipped and a round tipped fin. A

two component strain gage balance was used to measure the force and moment on the fins. Laser Doppler velocimetry techniques were used to measure velocity contours about the body and fin. Strain gage data was plotted for various angles of attack and Reynolds numbers ranging up to 5 million based on the chord length of the fin. These curves were combined to obtain lift versus angle of attack data for the two fins. From the laser velocity data, velocity plots were generated to verify location of vorticies. Numerical integration of the laser velocity data yielded circulation values for the velocity contours. Circulation, forces and theory are compared. Coefficient of lift versus angle of attack for the two fins, circulation values at various radii from the body, circulation values at various spans on the fin, and comparisons between the methods are presented. GRA

**N88-18555#** Calspan-Buffalo Univ. Research Center, N.Y.
**SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION IN HIGH-REYNOLDS-NUMBER HYPERSONIC FLOWS Annual Report, 1 Sep. 1985 - 30 Sep. 1986**
M. S. Holden, A. G. Havener, and C. H. Lee Jul. 1987 137 p
(Contract F49620-85-C-0130)
(AD-A188029; CUBRC-86681; AFOSR-87-1587TR) Avail: NTIS HC A07/MF A01 CSCL 20D

This report investigated fundamental aerothermal phenomena in hypersonic flow, with particular emphasis on viscous/inviscid interaction phenomena. The experimental studies were conducted to examine the changes in the structure at the base of a hypersonic turbulent boundary layer as it is subjected to a strong self-induced pressure gradient in regions of shock wave/boundary layer interaction. The initial phase of the theoretical program was directed toward summarizing existing techniques for obtaining Navier/Stokes solutions for laminar flow over flat plates in hypersonic flow. In the experimental program, surface and flow field measurements were made to examine the detailed flow mechanics associated with turbulent boundary layer separation over a large cone flare model at Mach numbers 11, 13 and 16 and Reynolds numbers up to 100 million. Holography measurements were used to examine the flow field regions of hypersonic shock wave/turbulent boundary layer interaction. In this preliminary investigation of the application of holography in a 96 inch Shock Tunnel, holographic interferograms were obtained for viscous/inviscid interactions at Mach numbers 11 and 13 and Reynolds numbers up to 30 million, nominally. Flow field studies were made for flat plate/wedge, cone/flare and incident shock configurations. The quantitative results presented offer new information as well as a potential to obtain density measurements in other types of hypersonic flow; however, they also reveal important concerns which need to be resolved before the interferometric data can be claimed to give accurate measurements of these flows. GRA

**N88-18556#** National Aerospace Lab., Tokyo (Japan).
**CONDITIONS AT INFINITY FOR THEORIES OF OSCILLATING WINGS AND PROPELLERS IN SUBSONIC FLOW**
Teruo Ichikawa Jul. 1987 10 p In JAPANESE; ENGLISH summary
(NAL-TR-937; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Conditions at infinity that should be satisfied by the acceleration potential of the flow field around oscillating wings or propellers in a uniform subsonic flow are given in simple forms. It is shown that the value of the integral on the boundary surface at infinity in Green's formula becomes zero by virtue of these conditions, if, in addition, reasonable conditions at infinity are assigned for the fundamental solution of the adjoint equation of the governing differential equation. Author

**N88-18557*#** Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.
**AN EXPERIMENTAL INVESTIGATION OF STRAIGHT AND CURVED ANNULAR WALL JETS**
L. C. Rodman, N. J. Wood, and L. Roberts Sep. 1987 173 p
(Contracts NCC2-173; NCC2-331; NCC2-376)
(NASA-CR-182546; NAS 1.26:182546; JIAA-TR-79) Avail: NTIS HC A08/MF A01 CSCL 01A

Accurate turbulence measurements taken in wall jet flows are difficult to obtain, due to high intensity turbulence and problems in achieving two-dimensionality. The problem is compounded when streamwise curvature of the flow is introduced, since the jet entrainment and turbulence levels are greatly increased over the equivalent planar values. In this experiment, two-dimensional straight and curved incompressible wall jet flows are simulated by having a jet blow axially over a cylinder. Hot wire measurements and some Laser Doppler Velocimetry measurements are presented for straight and curved wall jet flows. The results for the straight wall showed good agreement between the annular flow data and the rectangular data taken by previous researchers. For the jets with streamwise curvature, there was agreement between the annular and corresponding rectangular jets for the flow region closest to the slot exit. An integral analysis was used as a simple technique to interpret the experimental results. Integral momentum calculations were performed for both straight and curved annular and two dimensional wall jets. The results of the calculation were used to identify transverse curvature parameters and to predict the values of those parameters which would delineate the region where the annular flow can satisfactorily simulate two dimensional flow. Author

**N88-18558*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**ON THE SMALLEST SCALE FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS Final Report**
W. D. Henshaw, H. O. Kreiss, and L. G. Reyna (IBM Watson Research Center, Yorktown Heights, N.Y.) Jan. 1988 52 p Submitted for publication
(Contracts NAS1-18107; N00014-83-K-0422; Grant NSF DMS-83-12264)
(NASA-CR-181628; ICASE-88-8; NAS 1.26:181628) Avail: NTIS HC A04/MF A01 CSCL 01A

It is proven that for solutions to the two- and three-dimensional incompressible Navier-Stokes equations the minimum scale is inversely proportional to the square root of the Reynolds number based on the kinematic viscosity and the maximum of the velocity gradients. The bounds on the velocity gradients can be obtained for two-dimensional flows, but have to be assumed to be three-dimensional. Numerical results in two dimensions are given which illustrate and substantiate the features of the proof. Implications of the minimum scale result to the decay rate of the energy spectrum are discussed. Author

**N88-18559*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**FLUCTUATIONS AND MASSIVE SEPARATION IN THREE-DIMENSIONAL SHOCK-WAVE/BOUNDARY-LAYER INTERACTIONS**
M. I. Kussoy, J. D. Brown (National Academy of Sciences - National Research Council, Washington, D. C.), J. L. Brown, W. K. Lockman, and C. C. Horstman [1988] 13 p
(Contract NCC2-452)
(NASA-TM-89224; NAS 1.15:89224) Avail: NTIS HC A03/MF A01 CSCL 01A

Shock-wave unsteadiness was observed in rapidly compressed supersonic turbulent boundary layer flows with significant separation. A Mach 2.85 shock-wave/turbulent boundary layer flow was set up over a series of cylinder-flare bodies in the High Reynolds Number Channel 1. The transition from fully attached to fully separated flow was studied using axisymmetric flares with increasing compression angles. In the second phase, the 30 deg flare was inclined relative to the cylinder axis, so that the effect on a separated flow of increasing 3 dimensionality could be observed. Two 3-D separated cases are examined. A simple conditional sampling technique is applied to the data to group them according to an associated shock position. Mean velocities and turbulent kinetic energies, computed from the conditionally samples data, are compared to those from the unsorted data and to computed values. Three basic questions were addressed: can conditional sampling be used to provide snapshots of the flow; are averaged turbulence quantities dominated by the bimodal nature

of the interaction; and is the shock unsteadiness really important to computational accuracy. B.G.

**N88-18560#** Sandia National Labs., Albuquerque, N. Mex. Computational Aerodynamics Div.
**COMPARISONS OF MONTE-CARLO AND PNS (PARABOLIZED NAVIER-STOKES) CALCULATIONS FOR RAREFIED FLOW OVER REENTRY VEHICLE CONFIGURATIONS**
Timothy J. Bartel, Mary A. Walker, and Gregory F. Hornicz 1988 24 p Presented at the 26th AIAA Aerospace Conference, Reno, Nev., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004937; SAND-87-1561C; CONF-880139-3) Avail: NTIS HC A03/MF A01

The hypersonic flow field solutions obtained from both a kinetic and a continuum model of the rarefied flow about geometries typical of those found in aerospace applications are compared. Experimental data, where available, are also compared to the predictions. The kinetic model used is Bird's Direct-Simulation Monte-Carlo (DSMC) algorithm. The continuum model is based on the widely-used Parabolized Navier-Stokes (PNS) equations. The configurations include a sharpened cone, and spherically-blunted biconic and triconic configurations; all assume 2-D axisymmetric flow at zero angle-of-attack. The Knudsen number of the flows, based on freestream conditions, varied from approximately 10 to the minus 3 power to 1. While the comparisons with experimental data are limited to global quantities such as the drag coefficient, numerical results are also presented for surface distributions of pressure and heat transfer, and density and temperature profiles in the flow field. Difficulties encountered with both solution procedures are discussed. DOE

**N88-18561** Ohio State Univ., Columbus.
**ON THE STABILITY OF THE SUPERSONIC BOUNDARY LAYER**
Mohamed Abdel-Latif Elsharnoby 1987 224 p
Avail: Univ. Microfilms Order No. DA8717629

The present analysis of the stability of supersonic flow utilizes the assumption of parallel flow in the derivation of the complete system of linearized stability equations including the existence of the more unstable oblique disturbances. Accurate variations of gas properties are used together with the numerical technique of Mack to obtain a large number of stability results. The main goal is to determine accurately the repsonse of the second-mode disturbances to changes in Mach number and wall temperature; however, first-mode results are presented as well. Two computer programs were produced. The first solves the compressible boundary-layer equations for any Mach number and wall temperature. The second computes the eigensolutions of the linearized stability equations. The two computer programs were modified to investigate the stability of compressible flow with viscosity proportional to temperature. Other effects studied included the thermal boundary condition imposed on the temperature fluctuation at the surface, the direction of wave propagation, the viscosity model and the Prandtl number variations. Dissert. Abstr.

**N88-18562** Colorado Univ., Boulder.
**EXPERIMENTAL STUDY OF TWO-DIMENSIONAL VORTEX PATTERNS FOR IMPULSIVELY STARTED BODIES IN COMPARISON WITH OTHER CONFIGURATIONS Ph.D. Thesis**
Fathi A. Finaish 1987 196 p
Avail: Univ. Microfilms Order No. DA8723456

A new experimental system that generates and visualizes impulsive starting flow and accelerating starting flow over bluff bodies was designed. Utilizing the techniques of direct injection of liquid titanium tetrachloride, the vortex pattern developments over bluff bodies in impulsive and accelerating flow were visualized surveying the flow over a wide range of the parameter space. The photographic sequences of flow visualizations were utilized to conduct a parametric analysis that quantifies the important features of impulsive and accelerating flow developments over airfoils. Furthermore, some of the physical flow visualizations were compared to the numerical flow visualizations reported in the literature. The results provide a source for comparison with other unsteady flow histories and verification reference for computer simulations. Novel vortex patterns and developments have been identified which represent a challenge for future measurements and future parametric computer studies. Dissert. Abstr.

**N88-18563** California Inst. of Tech., Pasadena.
**ON THE START UP OF SUPERSONIC UNDEREXPANDED JETS Ph.D. Thesis**
Nehemias Lima Lacerda 1987 124 p
Avail: Univ. Microfilms Order No. DA8719676

The effects of the pressure ratio between the high pressure gas inside a reservoir, as well as the gas combination used, are studied. The initial development of a jet formed from such a reservoir is highly time dependent. During this phase, the shape that the jet assumes varies with pressure ratio and with the choice of gas. After the jet starts, a Mach disk is observed close to the jet exit which moves downstream as the exit pressure builds up. The monotonic increase in exit pressure is caused by the slow breaking of the diaphragm. The position of the Mach disk is furthest from the jet exit when the exit pressure is a maximum. After that it oscillates at a frequency close to one of the resonant frequencies of the reservoir. The frontal part of the jet forms the jet head, whose shape changes with the flow conditions. The initial evolution of the jet head is linear but after propagating a distance of around ten exit diameters, it reaches asymptotic behavior with an evolution that is approximately proportional to square root of time. The head creates a bow shock that was found to be less attenuated than in spherically symmetric explosions. Dissert. Abstr.

**N88-18564#** Sandia National Labs., Albuquerque, N. Mex.
**ANALYSIS OF SHEAR-LAYER PROBE DATA FOR HOLES IN HYPERSONIC CONFIGURATIONS**
J. J. Bertin, W. J. Tedeschi, D. P. Kelly, A. C. Bustamante, and E. W. Reece 1988 42 p Presented at the 26th AIAA Aerospace Conference, Reno, Nev., 10 Jan. 1988 Prepared in cooperation with Texas Univ., Austin
(Contract DE-AC04-76DP-00789)
(DE88-003992; SAND-87-1226C; CONF-880139-2; AIAA-88-0373)
Avail: NTIS HC A03/MF A01

Vehicles entering the Earth's atmosphere are subjected to a severe aerothermodynamic environment. If there is an opening in the surface that allows flow into the interior cavities of the reentry vehicle (RV), the complex viscous/inviscid interactions that are produced can cause increases in the aerodynamic loads and locally severe increases in heating. If a tile or a portion of a surface panel of the Space Shuttle Orbiter were to be inadvertently lost, the increased severity of the aerothermodynamic environment could jeopardize the mission of the Orbiter. In other instances, a foreign object could impact the surface of the reentry vehicle with such force as to damage the surface of the RV. Other surface openings (or ports) may be designed into reentry vehicles and proper account must be taken of the internal heating within these cavities. The effect of surface openings on the aerothermodynamic environment has been the subject of numerous investigations. A series of test programs have been conducted in Tunnel B of the Arnold Engineering Development Center (AEDC) in which wedges were exposed to the Mach 8 stream. The model design was such that one of several external surface ports, or ESPs, could be located in the wedge surface, exposing an internal cavity to the external flow. This report describes the test methods, code development and numerical analysis, and provides the experimental data obtained. DOE

**N88-18565*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**PRESSURE DISTRIBUTIONS FROM HIGH REYNOLDS NUMBER TRANSONIC TESTS OF AN NACA 0012 AIRFOIL IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL**
Charles L. Ladson, Acquilla S. Hill, and William G. Johnson, Jr. Dec. 1987 396 p

(NASA-TM-100526; NAS 1.15:100526) Avail: NTIS HC A17/MF A01 CSCL 01A

Tests were conducted in the 2-D test section of the Langley 0.3-meter Transonic Cryogenic Tunnel on a NACA 0012 airfoil to obtain aerodynamic data as a part of the Advanced Technology Airfoil Test (ATAT) program. The test program covered a Mach number range of 0.30 to 0.82 and a Reynolds number range of 3.0 to 45.0 x 10 to the 6th power. The stagnation pressure was varied between 1.2 and 6.0 atmospheres and the stagnation temperature was varied between 300 K and 90 K to obtain these test conditions. Tabulated pressure distributions and integrated force and moment coefficients are presented as well as plots of the surface pressure distributions. The data are presented uncorrected for wall interference effects and without analysis. Author

**N88-18566*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**TOTAL VARIATION DIMINISHING (TVD) SCHEMES OF UNIFORM ACCURACY**

Peter-M. Hartwich, Chung-Hao Hsu (Vigyan Research Associates, Inc., Hampton, Va.), and C. H. Liu Jan. 1988 33 p Presented at the 1st International Conference on Industrial and Applied Mathematics, Paris, France, 29 Jun. - 30 Jul. 1987

(NASA-TM-100552; NAS 1.15:100552) Avail: NTIS HC A03/MF A01 CSCL 01A

Explicit second-order accurate finite-difference schemes for the approximation of hyperbolic conservation laws are presented. These schemes are nonlinear even for the constant coefficient case. They are based on first-order upwind schemes. Their accuracy is enhanced by locally replacing the first-order one-sided differences with either second-order one-sided differences or central differences or a blend thereof. The appropriate local difference stencils are selected such that they give TVD schemes of uniform second-order accuracy in the scalar, or linear systems, case. Like conventional TVD schemes, the new schemes avoid a Gibbs phenomenon at discontinuities of the solution, but they do not switch back to first-order accuracy, in the sense of truncation error, at extrema of the solution. The performance of the new schemes is demonstrated in several numerical tests. Author

**N88-18567*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

**EFFECTS OF WINGLETS ON A FIRST-GENERATION JET TRANSPORT WING. 7: SIDESLIP EFFECTS ON WINGLET LOADS AND SELECTED WING LOADS AT SUBSONIC SPEEDS FOR A FULL-SPAN MODEL**

Robert R. Meyer, Jr. and Peter F. Covell Sep. 1986 60 p

(NASA-TP-2619; H-1193; NAS 1.60:2619) Avail: NTIS HC A04/MF A01 CSCL 01A

The effect of sideslip on winglet loads and selected wing loads was investigated at high and low subsonic Mach numbers. The investigation was conducted in two separate wind tunnel facilities, using two slightly different 0.035-scale full-span models. Results are presented which indicate that, in general, winglet loads as a result of sideslip are analogous to wing loads caused by angle of attack. The center-of-pressure locations on the winglets are somewhat different than might be expected for an analogous wing. The spanwise center of pressure for a winglet tends to be more inboard than for a wing. The most notable chordwise location is a forward center-of-pressure location on the winglet at high sideslip angles. The noted differences between a winglet and an analogous wing are the result of the influence of the wing on the winglet. Author

**N88-18568#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

**PERFORMANCE SURVEY OF AIRFOIL PROFILES [LEISTUNGSVERMESSUNG VON FLUEGELPROFILEN]**

[1987] 4 p In GERMAN

(ETN-88-91093) Avail: NTIS HC A02/MF A01

In flight pressure measurements on airfoil profiles were performed in order to eliminate the influence of noise and turbulence in laminar wind tunnels. The profile model was mounted 2.5 m above the wing of a glider. The angle of attack of the profile model could be varied. The measurements were performed in aircraft towing as well as in free flight, in quiet and cloudless weather conditions, at heights between 1000 and 3000 m. The static pressure was measured at 65 positions along the contour at a central cross section of the profile model resulting in a buoyancy coefficient and a pitching moment coefficient. At 70 other positions behind the profile model the global and static pressure in the wake were calculated resulting in a drag coefficient. ESA

**N88-18569#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

**INVESTIGATIONS OF THE LAMINAR-TURBULENT BOUNDARY LAYER TRANSITION FOR THE IMPROVEMENT OF THE PERFORMANCE OF POWERED GLIDER AIRCRAFT PROFILES [UNTERSUCHUNGEN ZUM LAMINAR-TURBULENTEN UMSCHLAG DER GRENZSCHICHT ZUR LEISTUNGSVERGESSERUNG VON TRAGFLUEGELPROFILEN UND MOTORFLUGZEUGEN]**

[1987] 4 p In GERMAN

(ETN-88-91094) Avail: NTIS HC A02/MF A01

The laminar-turbulent boundary transition at airfoil profiles was investigated with a view to the extension of glider airfoil profile technology to commuter and passenger aircraft. Flight and wind tunnel tests were performed with a power glider equipped with a glove around the airfoil for the measurement of the static pressure distribution. The experimental data provide an empirical basis for the transition calculation method, based on stability theory. The transition was determined using IR techniques and thermography. The experimental results permit establishment of a correlation between flight data and wind tunnel data. ESA

**N88-18570*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**AN APPLICATION OF ACTIVE SURFACE HEATING FOR AUGMENTING LIFT AND REDUCING DRAG OF AN AIRFOIL**

Lucio Maestrello, Forooz F. Badavi (PRC Kentron, Inc., Hampton, Va.), and Kevin W. Noonan Mar. 1988 17 p

(NASA-TM-100563; NAS 1.15:100563) Avail: NTIS HC A03/MF A01 CSCL 01A

Application of active control to separated flow on the RC(6)-08 airfoil at high angle of attack by localized surface heating is numerically simulated by integrating the compressible 2-D nonlinear Navier-Stokes equation solver. Active control is simulated by local modification of the temperature boundary condition over a narrow strip of the upper surface of the airfoil. Both mean and perturbed profiles are favorably altered when excited with the same natural frequency of the shear layer by moderate surface heating for both laminar and turbulent separation. The shear layer is found to be very sensitive to localized surface heating in the vicinity of the separation point. The excitation field at the surface sufficiently altered both the local as well as the global circulation to cause a significant increase in lift and reduction in drag. Author

**N88-18571*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**HIGH REYNOLDS NUMBER TRANSONIC TESTS ON A NACA 0012 AIRFOIL IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL**

Charles L. Ladson and S. Acquilla Hill Dec. 1987 150 p

(NASA-TM-100527; NAS 1.15:100527) Avail: NTIS HC A07/MF A01 CSCL 01A

Tests were conducted in the two-dimensional test section of the Langley 0.3-m Transonic Cryogenic Tunnel on a NACA 0012 airfoil to obtain aerodynamic data as a part of the Advanced Technology Airfoil Test (ATAT) program. The test program covered a Mach number range of 0.30 to 0.82 and a Reynolds number range of 3.0 to 45.0 x 10 to the 6th. The stagnation pressure was

varied between 1.2 and 6.0 atmospheres and the stagnation temperature was varied between 300 K and 90 K to obtain these test conditions. Plots of the spanwise variation of drag coefficient as a function of normal force coefficient and the variation of the basic aerodynamic characteristics with angle of attack are shown. The data are presented uncorrected for wall interference effects and without analysis. Author

**N88-18572*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**PAYLOAD BAY ATMOSPHERIC VENT AIRFLOW TESTING AT THE VIBRATION AND ACOUSTIC TEST FACILITY**
James D. Johnston, Jr. Feb. 1988 35 p
(NASA-TM-100460; S-572; NAS 1.15:100460) Avail: NTIS HC A03/MF A01 CSCL 01A

Several concerns related to venting the Space Shuttle Orbiter payload bay during launch led to laboratory experiments with a flight-type vent box installed in the wall of a subsonic wind tunnel. This report describes the test setups and procedures used to acquire data for characterization of airflow through the vent box and acoustic tones radiated from the vent-box cavity. A flexible boundary-layer spoiler which reduced the vent-tone amplitude is described. Author

**N88-19189** Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany). Inst. fuer Methodische Grundlagen.
**A MULTIGRID SOLVER FOR TWO-DIMENSIONAL TRANSONIC FULL POTENTIAL FLOW CALCULATIONS**
K. Becker *In its* Multigrid Methods: Special Topics and Applications May 1987 p 25-34 (For primary document see N88-19187 11-64)
Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

**N88-19195** Israel Aircraft Industries Ltd., Lod.
**A MULTIGRID FULL POTENTIAL TRANSONIC CODE FOR ARBITRARY CONFIGURATIONS**
A. L. Luntz and B. Epstein *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 111-120 (For primary document see N88-19187 11-64)
Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

# 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**N88-18573#** Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
**PROCEEDINGS OF A WORKSHOP ON INNOVATIVE SOLUTIONS FOR SAFETY IN AIR TRANSPORTATION [VORTRAEGE ZUM WORKSHOP: INNOVATIVE LOESUNGEN FUER DIE SICHERHEIT IM LUFTVERKEHR]**
Manfred Fricke, Rudolf Elsner, Frank Ziegler, Michael Brandes, Juergen Fay, Peter Form, Klaus-Peter Berg, Andreas Herber, Roland Mallwitz, and Heinrich Eckhardt (Bundesministerium fuer Verkehr, Bonn, West Germany ) et al. 1987 253 p In GERMAN Proceedings held in Berlin, West Germany, 27-28 Apr. 1987
(ILR-Mitt-178(1987); ETN-88-90796) Avail: NTIS HC A12/MF A01

Data transmission for navigation and supervision, especially, the use of the secondary radar system (SSR) mode-S, which allows a selective communication between ground and aboard; collision avoidance with SSR mode-S; experimental measuring of the SSR field; automatic control; air traffic management planning; air traffic simulation models; and the Computer Oriented Metering Planning and Advisory System for approach flight are discussed. ESA

**N88-18574*#** Atmospheric Science Associates, Concord, Mass.
**THREE-DIMENSIONAL TRAJECTORY ANALYSES OF TWO DROP SIZING INSTRUMENTS: PMS OAP AND PMS FSSP Final Report**
Hillyer G. Norment Washington NASA Feb. 1988 65 p
(Contract NAS3-24630)
(NASA-CR-4113; E-3851; NAS 1.26:4113; DOT/FAA/CT-87/30)
Avail: NTIS HC A04/MF A01 CSCL 01C

Flow induced distortions of water drop fluxes and speeds seen by the instruments were predicted by use of three dimensional flow and trajectory calculation methods. Sensitivities were determined for the instruments, in isolation and mounted under the wing of an airplane, to: water drop diameter (2 to 1000 microns), angle of attack and free stream air speed. For the optical array probe in isolation and on the airplane at 0 deg angle of attack, flux distortions of practical consequence are not found. At 4 deg airplane angle of attack, partial flow stagnation under the uptilted wing causes significant decreases in both flux and speed for cloud size droplets. For the forward scattering spectrometer probe in isolation, only marginally significant sensitivities to free stream air speed are found, and no sensitivity is found to angle of attack. Both speed and flux of cloud size droplets are predicted to be undermeasured by from 12 to 24 percent depending on airplane angle of attack. For the wing-mounted instruments, effects of flow about the instruments themselves are found to be equal in importance to effects of flow about the airplane. Preferred orientation (canting) angles of distorted water drops are found to be functions of drop size, angle of attack and air speed. Author

**N88-18575#** National Transportation Safety Board, Washington, D. C.
**AIRCRAFT ACCIDENT REPORT: MIDAIR COLLISION OF US ARMY BEECH U-21A, ARMY 18061, AND SACHS ELECTRIC COMPANY PIPER PA-31-350, N60SE, INDEPENDENCE, MISSOURI, JANUARY 20, 1987**
3 Feb. 1988 62 p
(NTSB/AAR-88/01) Avail: NTIS HC A04/MF A01

On January 20, 1987, a Beech U-21A and a Piper PA-31-350 collided at 7,000 ft msl over Independence, Missouri, about 5 miles east of the eastern boundary of the Kansas City Terminal Control Area. The U-21 was level at 7,000 ft and en route to Ft. Leavenworth, Kansas, according to instrument flight rules. The PA-31 was climbing eastbound to an unknown cruise altitude, according to visual flight rules, en route to St. Louis, Missouri. The airplanes collided head-on in daylight and visually clear conditions. Although both planes were equipped with operating mode-C transponders, the radar controllers in communication with the U-21 did not observe and were not alerted to the conflict. Therefore, traffic advisories were not provided. As a result of the accident 2 pilots and 1 passenger aboard the U-21 and the pilot and 2 passengers aboard the PA-31 were fatally injured. Both planes were destroyed. The NTSB determines that the probable cause of the accident was the failure of the radar controllers to detect the conflict and to issue traffic advisories or a safety alert to the flightcrew of the U-21; deficiencies of the see and avoid concept; and lack of automated redundancy in the air traffic control system to provide conflict detection. Author

**N88-18576#** Amt fuer Wehrgeophysik, Traben-Trarbach (West Germany).
**PROTECTED AREAS WITH ENHANCED BIRD-AIRCRAFT COLLISION RISK IN THE FEDERAL REPUBLIC OF GERMANY [SCHUTZGEBIETE MIT ERHOEHTER VOGELSCHLAGGEFAHR IN DER BUNDESREPUBLIK DEUTSCHLAND]**
Juergen Becker, Jochen Hild, Ekkehard Kuesters, and Gesine Sturm Mar. 1987 43 p In GERMAN Map as supplement
(GeophysBDBw-FM-209; ISSN-0342-6025; ETN-88-91100) Avail: NTIS HC A03/MF A01

Bird-aircraft collisions were studied, and maps of areas with enhanced collision risk were made. Bird weights and impact

energies, dangerous times, dangerous heights, and the number of birds are discussed. The behavior of pilots with a view to the avoidance of bird-aircraft collisions is presented. The perturbation of the bird world by aircraft is explained. A list and a map of protected areas with enhanced collision risk are given. ESA

# 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

**N88-18577#** Naval Postgraduate School, Monterey, Calif.
**A COMPUTER SIMULATION STUDY OF AN EXPERT SYSTEM FOR WALKING MACHINE MOTION PLANNING M.S. Thesis**
Richard P. Goodpasture Dec. 1987 103 p
(AD-A187907; NPS-52-87-049) Avail: NTIS HC A06/MF A01 CSCL 17G

A basic algorithm for motion planning of an autonomous robotic vehicle is developed and presented in this study. The algorithm is implemented using simple rules in an expert system shell. This algorithm will allow autonomous vehicles with only rudimentary sensory abilities to navigate from point A to point B with no previous knowledge of the terrain. For this study, the algorithm is implemented with a KEE expert system shell on a Texas Instrument Explorer Lisp machine and controls a color graphics computer simulation of the Ohio State University Adaptive Suspension Vehicle. GRA

**N88-18578#** Naval Postgraduate School, Monterey, Calif.
**A CONCEPTUAL DESIGN OF AN INERTIAL NAVIGATION SYSTEM FOR AN AUTONOMOUS SUBMERSIBLE TESTBED VEHICLE M.S. Thesis**
Rex G. Putnam, Jr. Sep. 1987 131 p
(AD-A188038) Avail: NTIS HC A07/MF A01 CSCL 17G

The autonomous submersible testbed vehicle is arguablely the single most useful tool available to the submarine designer for designing modern technologically advanced submarines. The submarine's need for advancement and breakthrough capabilities has never been more critical. The autonomous submersible testbed vehicle is designed to provide those advancements and breakthroughs to the United States Navy. A likely envisionment of the autonomous submersible vehicle is derived. GRA

**N88-18579*#** Boeing Commercial Airplane Co., Seattle, Wash.
**COCKPIT DATA MANAGEMENT Final Report**
J. L. Groce and G. P. Boucek Feb. 1988 78 p
(Contract NAS1-18027)
(NASA-CR-178407; NAS 1.26:178407) Avail: NTIS HC A05/MF A01 CSCL 01D

This study is a continuation of an FAA effort to alleviate the growing problems of assimilating and managing the flow of data and flight related information in the air transport flight deck. The nature and extent of known pilot interface problems arising from new NAS data management programs were determined by a comparative timeline analysis of crew tasking requirements. A baseline of crew tasking requirements was established for conventional and advanced flight decks operating in the current NAS environment and then compared to the requirements for operation in a future NAS environment emphasizing Mode-S data link and TCAS. Results showed that a CDU-based pilot interface for Mode-S data link substantially increased crew visual activity as compared to the baseline. It was concluded that alternative means of crew interface should be available during high visual workload phases of flight. Results for TCAS implementation showed substantial visual and motor tasking increases, and that there was little available time between crew tasks during a TCAS encounter. It was concluded that additional research should be undertaken to address issues of ATC coordination and the relative benefit of high workload TCAS features. Author

**N88-18580*#** Boeing Commercial Airplane Co., Seattle, Wash.
**COCKPIT DATA MANAGEMENT**
J. L. Groce and G. P. Boucek Feb. 1988 316 p Original contains color illustrations
(Contract NAS1-18027)
(NASA-CR-178407-Suppl; NAS 1.26:178407-Suppl) Avail: NTIS HC A14/MF A01 CSCL 01D

The supplement (Volume 2) to NASA CR-178407, Cockpit Data Management, presents the test data for the FAA study to ease data flow problems on air transport flight decks. Author

**N88-18581** Bundesanstalt fuer Flugsicherung, Frankfurt am Main (West Germany).
**[ACTIVITIES REPORT IN AIR TRAFFIC CONTROL] Annual Report, 1986 [JAHRESBERICHT 1986]**
Jul. 1987 50 p In GERMAN
(ETN-88-91092) Copyright Avail: Issuing Activity

Measures to improve the safety and regularity in air traffic are presented. Navigation and radio telephony, information transfer, radars, information systems, and operation of electronic data processing systems are outlined. The results of the testing of several air traffic control aids are given. ESA

# 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

**N88-18582*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**AIRCRAFT AND GROUND VEHICLE FRICTION CORRELATION TEST RESULTS OBTAINED UNDER WINTER RUNWAY CONDITIONS DURING JOINT FAA/NASA RUNWAY FRICTION PROGRAM**
Thomas J. Yager, William A. Vogler, and Paul Baldasare (PRC Kentron, Inc., Hampton, Va.) Mar. 1988 28 p Presented at the Annual International Aviation Snow Symposium, Buffalo, N.Y., 26-29 Apr. 1987; sponsored by the American Association of Airport Executives
(NASA-TM-100506; NAS 1.15:100506) Avail: NTIS HC A03/MF A01 CSCL 01C

Aircraft and ground vehicle friction data collected during the Joint FAA/NASA Runway Friction Program under winter runway conditions are discussed and test results are summarized. The relationship between the different ground vehicle friction measurements obtained on compacted snow- and ice-covered conditions is defined together with the correlation to aircraft tire friction performance under similar runway conditions. Author

**N88-18583*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**CORNERING CHARACTERISTICS OF THE MAIN-GEAR TIRE OF THE SPACE SHUTTLE ORBITER**
Robert H. Daugherty, Sandy M. Stubbs, and Martha P. Robinson Mar. 1988 29 p
(NASA-TP-2790; L-16370; NAS 1.60:2790) Avail: NTIS HC A03/MF A01 CSCL 01C

An experimental investigation was conducted at the NASA Langley Research Center to study the effects of various vertical load and yaw angle conditions on the cornering behavior of the Space Shuttle Orbiter main gear tire. Measured parameters included side and drag force, side and drag force coefficients, aligning torque, and overturning torque. Side force coefficient was found to increase as yaw angle was increased, but decreased as the vertical load was increased. Drag force was found to increase as

vertical load was increased at constant yaw angles. Aligning torque measurements indicated that the tire is stable in yaw. Author

**N88-18584#** Naval Postgraduate School, Monterey, Calif.
**COMPUTER PROGRAM FOR CONCEPTUAL TANDEM ROTOR HELICOPTER DESIGN M.S. Thesis**
Bruce A. Vandenbos Sep. 1987 61 p
(AD-A187832) Avail: NTIS HC A04/MF A01 CSCL 01C

The conceptual phase of a helicopter design includes comparison of configurations which will meet the specified performance requirements. To perform this comparison, the designer must have the proper tools at hand. This thesis presents an interactive program for the conceptual design of tandem rotor helicopters. It is intended to complement the existing single rotor design program written for the Helicopter Design course, AE-4306, taught at the Naval Postgraduate School, Monterey, Calif. This program manages the myriad of interrelated parameters by prompting for input, providing the opportunity for changes, and displaying the results. This relieves the designer of the tedious calculations and bookkeeping, thus allowing time for a more thorough analysis of the design. GRA

**N88-18585#** Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
**ARTIFICIAL AND NATURAL ICING TESTS OF AH-64, PHASE 2 Final Report, Nov. - Dec. 1986**
James M. Adkins and Ralph Woratschek Mar. 1987 220 p
(AD-A188231; USAEFA-84-23) Avail: NTIS HC A10/MF A01 CSCL 01C

Natural icing tests were conducted in Nov. to Dec. 1986 to establish a moderate icing envelope for the AH-64A Apache. The AH-64A ice protection and detection/rate measuring systems were found to be satisfactory and the aircraft demonstrated that it will have the capability to operate safely in icing conditions. A deficiency noted during testing was the high potential for engine foreign object damage due to shed ice from the mismatch at the joint between the fore and aft nose gearbox/cross shaft fairings. Eleven shortcomings identified included: the susceptibility of the helicopter engines to damage due to ice shed from the external airframe components; unpredictable failure of the blade deice system due to the design/operation of the K-3 contactor relay; the potential failure of the deice controller caused by penetration of oil and water into the unit; the inadvertent unplugging of the helmet communication cord; and the poor location of the ice protection system advisory lights/anti-ice control panel. No degradation of aircraft handling qualities was noted as a result of aircraft ice accretion. Activation of the engine anti-ice systems results in approximately 10 percent loss in power and 8 percent in range. GRA

**N88-18586** Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
**THE ESTIMATION OF TARGET TRAJECTORY PARAMETERS FROM CLOSEST POINT OF APPROACH (CPA) TIME MEASUREMENTS IN A FIELD OF ACOUSTIC SENSORS**
F. Dommermuth Mar. 1987 28 p In GERMAN; ENGLISH summary
(Contract BMVg-T/RF31/G022/G1312)
(FB-3-87; Lfd-260; ETN-88-91027) Copyright Avail: Issuing Activity

The flight path of a nonmaneuvering aircraft was determined using acoustic sensors. In plane geometry and with four sensors, the problem has a (nearly) closed-form solution. Monte Carlo simulation demonstrates that the solution is stable against a deviation from the hypothesis of zero target height, as long as the target velocity is not too high and the target height is not large in comparison with the distance betwen sensors. The feasibility of the procedure is demonstrated by application to real data. ESA

**N88-18587*#** Kansas Univ., Lawrence.
**PRESENTATION OF CLASS 1 DESIGNS FOR A FAMILY OF COMMUTER AIRPLANES Final Report**
Tom Creighton, George Dragush, Louis Hendrich, Doug Hensley, Louise Morgan, Charles Oxendine, John Remen, Terry Robinson, Mark Russell, and Jerry Swift Nov. 1986 431 p
(Grants NGT-21-002-080; NGT-80001)
(NASA-CR-182563; NAS 1.26:182563) Avail: NTIS HC A19/MF A01 CSCL 01C

The Class 1 configuration designs of a family of commuter aircraft are presented. The proposed aircraft will have a capacity of from 25 to 100 passengers. They are to have the following common features: (1) 2 aft fuselage mounted engines; (2) a low wing; (3) a T-tail type empennage; and (4) a tricycle type landing gear. A family concept is introduced to achieve structural, systems and handling quality commonality throughout. Implementing commonality can substantially reduce manufacturing and production costs. By achieving common system designs, maintenance costs can be reduced by permitting airlines to stock a smaller inventory of spares. Therefore, the higher degree of commonality, the lower the direct operating and life cycle costs. The attempt to implement some of the commonality requirements has caused configuration design problems, i.e., the twin-body concept was introduced. Design data are compared to existing aircraft, and the extent of structural, systems and handling qualities achieved are reviewed. F.M.R.

**N88-18588#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
**SOME ASPECTS OF AIRCRAFT DYNAMIC LOADS DUE TO FLOW SEPARATION**
D. G. Mabey (Royal Aircraft Establishment, Farnborough, England) Feb. 1988 33 p Presented at the 65th Meeting of the Structures and Materials Panel of AGARD, Cesme, Turkey, 4-9 Oct. 1987
(AGARD-R-750; ISBN-92-835-0445-3) Copyright Avail: NTIS HC A03/MF A01

Various topics associated with the study of Aircraft Dynamic Loads due to Flow Separation are discussed in this AGARD paper. Topics discussed include the need for consistent definitions of buffet and buffeting, the advantages of consistent notation for all the papers, buffeting due to wings and other components, the alleviation of buffeting, the special difficulties of flight tests and the special advantages of buffeting measurements in cryogenic wind tunnels. Author

**N88-18589*#** National Aeronautics and Space Administration, Washington, D.C.
**STORE SEPARATION AND MISSILE FIRING FROM AIRCRAFT: EXPERIMENTAL METHODS FOR TRAJECTORY PROJECTION**
M. J. Doulbeau Mar. 1988 38 p Transl. into ENGLISH of Largages et Tirs de Charges et de Missiles a Partir d'Avions Methodes Experimentales de Prevision de Trajectoires, presented at the 23rd Colloque d'Aerodynamique Appliquee, 1986 p 1-33 Meeting held in Modane, France, 12-14 Nov. 1986 Original language document was announced in IAA as A87-38035 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20214; NAS 1.77:20214) Avail: NTIS HC A03/MF A01 CSCL 01C

The accuracy of various methods used in wind tunnel experiments for the determination of the separation trajectory is investigated for various aircraft stores with flight test data. Trajectory analysis is performed with the aid of the geometric interface of an interactive 3-D numerical system. Low-velocity free drops are modeled using a Froude similarity criterion, and a six degrees-of-freedom system is used to study missile firings. With the exception of the rail-firing of missiles, good general agreement is found between separation data for the various stores considered, and the flight data. Initial conditions of the store that must be taken into consideration include variations of mass, center of gravity, Mach number, velocity, and incidence angle. Author

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

**N88-18590#** Army Avionics Research and Development Activity, Fort Monmouth, N. J.
**GENERATION OF SPECIFIC CHROMATICITIES ON CRT MONITORS**
Barbara Bernabe and William Keane Sep. 1987 58 p
(AD-A187739; AVSCOM-TR-85-E-5) Avail: NTIS HC A04/MF A01 CSCL 14B

The increased use of CRT displays for presenting the aviator with flight information has generated an increasing interest in the use of color for representing CRT display symbology. Critical to the implementation of color for this purpose is the development of standardized chromaticities for coding displayed features. Generation of specific chromaticities on CRT displays applied color matching principles using the chromaticities of CRT phosphors as the new set of primaries, and transforming their ratios in the generated color to those of a desired standard color. A procedure to implement this transformation was proposed by Gutmann and Rogers (1982), and further developed by Spiker and Rogers (1984). While their procedure was theoretically sound with respect to color mixing principles, it failed to produce predicted chromaticities when used in conjunction with a variety of commercial and aircraft CRT monitors. This result raised some perplexing issues with respect to the relationship between color display technology, the science of color mixing, and the psychophysics of color perception. This report attempts to clarify the problem of direct application of color mixing to CRT's and proposes a modified procedure for generating specific chromaticities on CRT displays suitable for use in a field environment. GRA

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**N88-18591#** Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
**DISK PUMPING TEST Final Report, Aug. 1983 - Feb. 1987**
D. J. Graber, W. A. Daniels, and B. V. Johnson Sep. 1987 103 p
(Contract F33615-83-C-2331)
(AD-A187199; PW/GPD-FR-19184; AFWAL-TR-87-2050) Avail: NTIS HC A06/MF A01 CSCL 21E

An experimental study of secondary flows in gas turbine engines was conducted with cold flow models to develop an understanding of the disk pumping flow characteristics within a variety of disk/cavity configurations. Turbine disk torque experiments were conducted with co-rotating, counter-rotating, and one rotating/one static coaxial disk combinations. The experiments were conducted with selected combinations of disk shape, diaphragm between the rotating disks, bolts, and partial bolt covers. Turbine rim seal ingestion experiments were conducted with four seal configurations using a CO2 trace gas measurement technique. Results showed the effects of gap spacing and seal configuration on the rim seal ingestion rate. Compressor drum aerodynamic experiments were conducted with a six cavity model and with coolant flow injected from three radial locations. Results showed the effects of coolant flowrate and coolant injection location on the pressure distribution in each cavity. Compressor drum heat-transfer experiments were conducted for heating and cooling transient flow conditions. The results were compared on a dimensionless basis with results from previous steady-state rotating heat-transfer experiments and from a free convection correlation for stationary plates. GRA

**N88-18592#** Naval Postgraduate School, Monterey, Calif.
**MEASUREMENTS OF GAS TURBINE COMBUSTOR AND ENGINE AUGMENTOR TUBE SOOTING CHARACTERISTICS M.S. Thesis**
Thomas A. Grafton, III Sep. 1987 68 p
(AD-A187831) Avail: NTIS HC A04/MF A01 CSCL 21B

A methodical investigation was conducted to examine soot particle sizing techniques and data acquisition apparatus so as to better understand soot particle properties in and immediately aft of a typical gas turbine combustor. Three wavelength light transmittance and multiple angle forward light scattering particle sizing techniques were used. The original objectives of this thesis were: (1) to modify the existing hardware to better simulate the flow behavior in an actual engine, (2) to obtain accurate particle sizing using a combination of transmittance and scattering measurements within the T-63 combustor, (3) to explore the effects that augmentor tube flow rate has on particle agglomeration and mass concentration, and (4) to reexamine the effects that varied fuel-air ratios have on the exhaust particle mean diameter. Mean particle sizes were found to be between .77 microns and .80 microns at the exit of the augmentor tube. GRA

**N88-18593#** Technical Research Centre of Finland, Espoo.
**GAS CLEANING AT HIGH TEMPERATURES AND PRESSURES FOR GAS TURBINES**
E. Kurkela and W. Mojtahedi Mar. 1987 114 p In FINNISH
(DE88-751171; VTT-TIED-689) Avail: NTIS (US Sales Only) HC A06/MF A01

In industrial gas turbine power plants based on pressurized fluid-bed combustion or gasification of solid fuels, gas cleaning at a high temperature and pressure constitutes the greatest problem. Problems caused by particles and alkali metals and their removal from hot flue gases and from product gases of gasification are discussed. The particle content of the gas to be led into the gas turbine must be reduced to prevent erosion. Estimates of the purity level required differ, i.e., a maximum particle content of 100 to 200 ppm. The content of greater than 10 micron particles should not exceed 1 ppm and that of greater than 5 micron particles 10 ppm. There are also different opinions about alkali metals and corrosion problems. Gas cleaning methods in gasification and fluid-bed combustion differ in many respects. In the gas turbine processes based on gasification the gas can also be purified conventionally at a low temperature. The volume flow of the gas to be cleaned is only 15 to 35 percent of that in fluid-bed combustion. The carbon content of the particles from gasification is usually 30 to 70 percent w/w/, whilst in fluid-bed combustion the content of unburnt carbon is less tha 5 percent w/w/. In the hot cleaning of gasification gas problems are caused especially by tarry impurities and, at certain temperatures, by carbon-forming reactions. Of the other purification methods, ceramic filters are considered most promising. Encouraging results have also been obtained from the use of electric precipitators at less 800 deg C temperatures. DOE

**N88-18594*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LIQUID SPRAYS AND FLOW STUDIES IN THE DIRECT-INJECTION DIESEL ENGINE UNDER MOTORED CONDITIONS**
Hung Lee Nguyen, Mark H. Carpenter, Juan I. Ramos (Carnegie-Mellon Univ., Pittsburgh, Pa.), Harold J. Schock, and James D. Stegeman Mar. 1988 80 p
(NASA-TM-100135; E-3685; NAS 1.15:100135) Avail: NTIS HC A05/MF A01 CSCL 21E

A two dimensional, implicit finite difference method of the control volume variety, a two equation model of turbulence, and a discrete droplet model were used to study the flow field, turbulence levels, fuel penetration, vaporization, and mixing in diesel engine environments. The model was also used to study the effects of engine speed, injection angle, spray cone angle, droplet distribution,

and intake swirl angle on the flow field, spray penetration and vaporization, and turbulence in motored two-stroke diesel engines. It is shown that there are optimum conditions for injection, which depend on droplet distribution, swirl, spray cone angle, and injection angle. The optimum conditions result in good spray penetration and vaporization and in good fuel mixing. The calculation presented clearly indicates that internal combustion engine models can be used to assess, at least qualitatively, the effects of injection characteristics and engine operating conditions on the flow field and on the spray penetration and vaporization in diesel engines. Author

**N88-18595#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**APPLICATION OF SIMILARITY TECHNIQUES BETWEEN REDUCED AND NATURAL SCALE MODELS OF RAMJET ENGINES [EMPREGO DE TECNICAS DE SIMILARIDADE ENTRE MODELOS DE ESTATO—REATORES EM ESCALE REDUZIDA E NATURAL]**
Demetrio Bastos Netto, Walter Gill, and Carlos Eduardo S. S. Migueis Jul. 1987 20 p In PORTUGUESE; ENGLISH summary
(INPE-4269-PRE/1142) Avail: NTIS HC A03/MF A01

The development of the solid fueled ramjet engine is of recent interest principally due to its application as a propulsion system for cruise missiles and its use as a sustainer stage for large space launch vehicles designed for horizontal takeoff. Due to the costs involved in the static testing of such propulsion systems, there naturally arises in the development phase a use of subscale models. This present work investigates the employment of similarity techniques used in determining relationships between the subscale model and the prototype taking into account the geometric parameters as well as the effects of fluid viscosity and thermal conductivity. Author

**N88-18596#** Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
**TECHNICAL-ECONOMICAL EVALUATION OF A NOVEL PROPFAN CONCEPT IN COMPARISON WITH THE TURBOFAN FOR THE NINETIES [TECHNISCHE/WIRTSCHAFTLICHE BEWERTUNG NEUER PROPFAN-KONZEPTE IM VERGLEICH ZUM TURBOFAN DER 90ER JAHRE]**
D. Eckardt 1986 25 p In GERMAN Presented at the 4th BMFT-Statusseminar Luftfahrtforschung und Luftfahttechnologie, Munich, Fed. Republic of Germany, 28-30 Apr. 1986
(ETN-88-91022) Avail: NTIS HC A03/MF A01

Propfan technology was compared with turbofan technology with a view to a short-haul passenger aircraft for 150 passengers, comparable to the Airbus A-320. A single rotation propfan, counter rotation propfan, as well as a pusher configuration were investigated. The advantages of the propfan propulsion systems (lower weight, lower fuel consumption) are largely compensated by the additional noise reduction measures. A hybrid propulsion system, (Counter-Rotating Integrated Shrouded Propfan), combining the advantages of the conventional turbofan systems and of the propfan configurations, is presented and discussed as an alternative for the conventional turbofan propulsion systems. Proposals for an experimental program are given. ESA

**N88-18597#** Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
**COUNTER-ROTATING INTEGRATED SHROUDED PROPFAN (CRISP): THE MTU PROPFAN PROGRAM [CRISP DAS MTU PROPFAN-PROGRAMM]**
D. Eckardt 1987 32 p In GERMAN Presented at the LPC-Tagung Airbus: Und sonst Nichts?, Bonn, Fed. Republic of Germany, 19 May 1987
(ETN-88-91023) Avail: NTIS HC A03/MF A01

The evolution of propulsion systems since 1950 is depicted, including the first flight of the General Electric/NASA unducted fan engine on a Boeing 727. The fuel consumption and weight of turbofan, propfan, and CRISP systems are compared. The development of shrouded propulsion systems for the mid-nineties is discussed. The fundamentals of the CRISP concept are given. Its advantages, as well as the requirement for new technologies are described. ESA

# 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

No abstracts in this category.

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

**N88-18598#** Army Construction Engineering Research Lab., Champaign, Ill.
**MICRO PAVER CONCEPT AND DEVELOPMENT AIRPORT PAVEMENT MANAGEMENT SYSTEM Final Report**
Mohamed Y. Shahin, Kathryn A. Cation, and Margaret R. Broten Jul. 1987 43 p
(Contract DTFA01-86-Z-02040)
(AD-A187360; CERL-TR-M-87/12; DOT/FAA/PM-87/8) Avail: NTIS HC A03/MF A01 CSCL 05A

Micro PAVER is a microcomputer version of the PAVER Pavement Maintenance Management System. PAVER is a field-tested, validated pavement maintenance management for airports, cities, counties, and military installations which is designed to optimize the funds allocated for pavement maintenance and rehabilitation (M and R). This report discusses the development of the Micro PAVER program and its capabilities in the areas of pavement network inventory, project prioritization, inspection scheduling, determining present and future network condition, determining maintenance and rehabilitation needs, budget planning, and economic analysis. The Micro PAVER technology is based on the Pavement Condition Index (PCI) survey and rating procedure developed at USA-CERL. The PCI, which is a numerical index from 0 to 100, is a measure of the pavement's structural integrity and operational condition and is computed as a function of distress type, severity, and quantity. The PCI provides an objective and consistent measure of pavement condition. Micro PAVER provides data and procedures for practical decisionmaking to identify cost-effective maintenance and rehabilitation needs for roads, streets, parking lots, and airfield pavements. GRA

**N88-18599#** Air Force Human Resources Lab., Brooks AFB, Tex.
**MEASUREMENT AND EFFECTS OF TRANSPORT DELAYS IN A STATE-OF-THE-ART F-16C FLIGHT SIMULATOR Final Report, Aug. 1985 - Sep. 1987**
Scott J. Horowitz Sep. 1987 18 p
(AD-A187367; AFHRL-TP-87-11) Avail: NTIS HC A03/MF A01 CSCL 12F

In recent years, the military community has developed advanced simulators for high-performance, fighter-type aircraft. These devices simulate not only high-performance aircraft but also complex tasks such as air-to-air combat, aerial refueling, air-to-ground combat, and formation flying. With the increases in the sophistication of these simulators has come a corresponding increase in computational complexity. This complexity has negated the effects

of higher computational speeds available in today's computers; thus, the transport delays have remained essentially constant. What has not remained constant, however, are the effects these transport delays have on the training effectiveness of these complex simulators. Because these modern simulators tend to be very complex in nature and consist of many computers interfaced with each other, the determination and measurements of the transport delays are often difficult. The effects these delays have on the simulation of a high-performance, fighter-type aircraft are also difficult to determine. The Air Force Human Resources Laboratory, Operations Training Division is currently completing the development of a new F-16C simulator with full-field-of-view visual display and no motion system. This paper describes the methods used to measure the transport delays that exist in this system and some of their effects on the training effectiveness of the simulation. GRA

**N88-18600#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
**PROBABILISTIC AND RELIABILITY DESIGN PROCEDURES FOR FLEXIBLE AIRFIELD PAVEMENTS: ELASTIC LAYERED METHOD Final Report**
Yu T. Chou Sep. 1987 72 p
(AD-A187533; WES/TR/GL-87-24) Avail: NTIS HC A04/MF A01 CSCL 01E

A procedure was developed to analyze layered elastic flexible pavement systems in terms of probability and reliability. A computer program RELIBISA was prepared to carry out the computations. Rosenblueth method, instead of the conventional Taylor series expansion, was used to estimate the expected value and variance of the strains (dependent parameters) based on the input mean values of independent parameters, i.e., aircraft load, layer thicknesses, and material moduli. The relationships between the reliability level and the allowable strain repetition of the designed system which is established with results computed using RELIBISA provide a decision-making tool for engineers to design pavements at desired reliability level. The design can be optimized by selecting thicknesses of the bituminous concrete and the base layers so that the pavement is failed in fatigue cracking and subgrade failure at nearly the same traffic level and the same reliability level. The reliability-strain curves have steeper slopes with the bituminous concrete strain failure criterion than with the subgrade strain failure criterion, indicating that for flexible pavements designed using the Corps of Engineer's failure criteria, the design has a greater degree of uncertainty in preventing subgrade failure than fatigue cracking of the bituminous concrete surface corps. However, this may not be true in real cases because the bituminous concrete failure criteria are determined based on controlled laboratory test data which do not consider the uncertainties existing in the laboratory-to-field correlation. GRA

**N88-18601#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
**PROFILOMETER FOR BOMB-DAMAGE-REPAIRED AIRFIELD PAVEMENTS AND MEASUREMENT OF PAVEMENT UPHEAVAL. REPORT 1: TECHNOLOGY EVALUATION Final Report, Apr. 1985 - Mar. 1986**
A. F. Stock and R. A. Bentsen Sep. 1987 63 p
(Contract MIPR-N-85-70; AF Proj. 2621)
(AD-A187985; AFESC/ESL-TR-87-21) Avail: NTIS HC A04/MF A01 CSCL 01E

Existing profilometers, each developed for highway applications, have limitations in respect to profiling bomb damage repaired airfield pavements. The components of existing profilometer systems are discussed in relation to the general requirements of a profilometer for bomb damage repaired pavements, as are each of the profilometers themselves. The conclusions drawn concerning the use of existing profilometer systems for bomb damaged airfield pavements are that they process profile data to provide information appropriate to highway operations; they do not function effectively at slow speeds, which may be necessary on an extensively damaged runway; and the costs prohibit supplying a unit to each station which may require expedient repair. Crater upheaval is the disturbance about the crater itself, which may not be detectable by the human eye. The string line method, presently used by the Air Force to detect crater upheaval, is difficult to perform and sometimes unreliable. Other possible methods are introduced and should be integrated into a test plan to determine the worthiness of each of crater upheaval detection. GRA

**N88-18602*#** Vigyan Research Associates, Inc., Hampton, Va.
**PRELIMINARY EXPERIMENTS ON SURFACE FLOW VISUALIZATION IN THE CRYOGENIC WIND TUNNEL BY USE OF CONDENSING OR FREEZING GASES**
M. J. Goodyer Jan. 1988 21 p
(Contract NAS1-17919)
(NASA-CR-181634; NAS 1.26:181634) Avail: NTIS HC A03/MF A01 CSCL 14B

Cryogenic wind tunnel users must have available surface flow visualization techniques to satisfy a variety of needs. While the ideal from an aerodynamic stand would be non-intrusive, until an economical technique is developed there will be occasions when the user will be prepared to resort to an intrusive method. One such method is proposed, followed by preliminary evaluation experiments carried out in environments representative of the cryogenic nitrogen tunnel. The technique uses substances which are gases at normal temperature and pressure but liquid or solid at cryogenic temperatures. These are deposited on the model in localized regions, the patterns of the deposits and their subsequent melting or evaporation revealing details of the surface flow. The gases were chosen because of the likelihood that they will not permanently contaminate the model or tunnel. Twenty-four gases were identified as possibly suitable and four of these were tested from which it was concluded that surface flow direction can be shown by the method. Other flow details might also be detectable. The cryogenic wind tunnel used was insulated on the outside and did not show signs of contamination. Author

# 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

# 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

# 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

**N88-18603#** Sparta, Inc., Del Mar, Calif.
**A LABORATORY RAILGUN FOR TERMINAL BALLISTICS AND ARC ARMATURE RESEARCH STUDIES Final Report, Jul. 1986 - Jan. 1987**
Daniel L. Vrable, Stuart N. Rosenwasser, and Kenneth J. Cheverton Jun. 1987 59 p
(Contract DAAA15-86-C-0071)

(AD-A187225; DM-87-02-TR; BRL-CR-572) Avail: NTIS HC A04/MF A01 CSCL 19F

A conceptual design was developed for a laboratory railgun suitable for both rac armature research and terminal ballistics studies. High utility and easy maintenance were the key design considerations. Parametric trade-off studies were conducted to evaluate and select the railgun parameters to achieve a system that accelerates a 120 gm launch package to 2 km/s. The design incorporates use of advanced materials for the bore components to minimize maintenance, and maximize performance through low bore erosion and deflection. The conceptual design includes features that allows easy replacement of the bore components for test evaluation; requires a minimum amount of manpower for assembly and operation; and has provision for the required test diagnostics. GRA

**N88-18604#** University Coll. of North Wales, Bangor. School of Electronic Engineering Science.

**MICROGRAVITY ISOLATION MOUNT Final Report, 21 Oct. 1985 - 28 Feb. 1987**

D. I. Jones, A. R. Owens, R. G. Owen, and G. Roberts Paris, France ESA 1987 18 p

(Contract ESA-6380/85-NL-AN)

(ESA-CR(P)-2480; ETN-88-91696) Avail: NTIS HC A03/MF A01

A microgravity isolation mount (MGIM) to isolate payloads--typically consisting of materials processing experimental packages--from the vibration of the spacecraft on-orbit was designed. The MGIM consists of a central massive platform to support the payloads, controlled in six degrees of freedom to remain adjacent to an outer frame installed within the spacecraft, but without making contact. The actuators, sensors, and control techniques necessary to achieve this are reviewed. The concept is validated by means of a simple computer model which predicts that the MGIM satisfies the required microaccelaration levels. A three degree of freedom test rig consisting of a platform supported on an air bed to give free motion in the horizontal plane is described. It is shown that with the vibration isolation units configured to act independently, performance is unacceptable. However, it is also shown that a different configuration, giving explicit angular control, overcomes this problem. ESA

**N88-18951*#** National Space Development Agency, Tokyo (Japan). Structural Test Dept.

**NASDA'S NEW TEST FACILITIES FOR SATELLITES AND ROCKETS**

Mitsuhiro Tsuchiya *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 79-90 (For primary document see N88-18948 11-39)

Avail: NTIS HC A10/MF A01 CSCL 09B

# 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

**N88-18605#** Institut Franco-Allemand de Recherches, St. Louis (France).

**EXPERIMENTAL DETERMINATION OF THE HEAT FLUX INSIDE A TUBULAR PROJECTILE FOR THE VELOCITY RANGE M = 3 AND M = 6 [EXPERIMENTELLE BESTIMMUNG DER WAERMSTROEME IM INNERN EINES HOHLGESCHOSSES IM MACHZAHLBEREICH 3 BIS 6 DETERMINATION EXPERIMENTALE DES FLUX DE CHALEUR A L'INTERIEUR D'UN PROJECTILE TUBULAIRE POUR LA GAMME DES VITESSES M = 3 ET M = 6]**

G. Smeets 29 Aug. 1986 21 p In FRENCH and GERMAN

(ISL-R-118/86; ETN-88-91641) Avail: NTIS HC A03/MF A01

Interior heat flux in a steel projectile was determined in a shock tube at Mach numbers 3 to 6 using a cylindrical model fitted with platinum thermometers. Results were extrapolated to those for flight near the ground by comparison with measures on the outside wall of a cylinder and by using a developed theory for turbulent boundary layers with high enthalpy. Results show that the method must be improved, as uncertainty is of the order of 15 percent. ESA

**N88-18606*#** Auburn Univ., Ala. Dept. of Aerospace Engineering.

**A TWO STAGE LAUNCH VEHICLE FOR USE AS AN ADVANCED SPACE TRANSPORTATION SYSTEM FOR LOGISTICS SUPPORT OF THE SPACE STATION Final Report**

Jun. 1987 315 p Sponsored by NASA, Marshall Space Flight Center, Huntsville, Ala.

(NASA-CR-182572; NAS 1.26:182572) Avail: NTIS HC A14/MF A01 CSCL 22B

This report describes the preliminary design specifications for an Advanced Space Transportation System consisting of a fully reusable flyback booster, an intermediate-orbit cargo vehicle, and a shuttle-type orbiter with an enlarged cargo bay. It provides a comprehensive overview of mission profile, aerodynamics, structural design, and cost analyses. These areas are related to the overall feasibility and usefullness of the proposed system. Author

**N88-18607*#** University of Central Florida, Orlando. Dept. of Mechanical Engineering and Aerospace Sciences.

**MODIFICATION OF INTEGRATED PARTIAL PAYLOAD LIFTING ASSEMBLY Final Report**

Melodie Groah, Michael Haddock, and Warren Woodworth 1986 30 p

(Grant NGT-80001)

(NASA-CR-182573; NAS 1.26:182573) Avail: NTIS HC A03/MF A01 CSCL 22B

The Integrated Partial Payload Lifting Assembly (IPPLA) is currently used to transport and load experimental payloads into the cargo bay of the Space Shuttle. It is unable to carry the astronaut/passenger tunnel without a structural modification. The purpose of this design is to create a removalbe modification that will allow the IPPLA to lift and carry the passenger tunnel. Modifications evaluated were full-length insert beams which would extend through the existing strongback arms. These beam proposals were eliminated because of high cost and weight. Other proposals evaluated were attachments of cantilever beams to the existing strongback areas. The cantilever proposals reduced cost and weight compared to the full-length modifications. A third method evaluated was to simply make modifications to one side of the IPPLA therefore reducing the materials of the cantilever proposals by 40 percent. The design of the modification selected was completed with two channel beams jointly welded to a centered steel plate. The extension arm modification is inserted into the existing strongback channel beams and bolted into place. Two extension arms are added to one side of the IPPLA to provide the extra length needed to accomodate the passenger tunnel. The center counterbalance will then be offset about 20 inches to center gravity and therefore maintain horizontal status. The extension arm modification was selected because of minimum cost, low weight, and minimal installation time. Author

**N88-18608*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**ASSESSMENT OF MIXED FLEET POTENTIAL FOR SPACE STATION LAUNCH AND ASSEMBLY**

L. J. DeRyder, ed. Dec. 1987 134 p

(NASA-TM-100550; NAS 1.15:100550) Avail: NTIS HC A07/MF A01 CSCL 22B

Reductions in expected STS flight rates of the Space Shuttle since the 51-L accident raise concerns about the ability of available launch capacity to meet both payload-to-orbit and crew rotation requirements for the Space Station. In addition, it is believed that some phases of Station build-up could be expedited using

unmanned launch systems with significantly greater lift capacity than the STS. Examined is the potential use of expendable launch vehicles (ELVs), yet-to-be-developed unmanned shuttle-derived vehicles (SDVs), and international launch vehicles for meeting overall launch requirements to meet Space Station program objectives as defined by the 1986 Critical Evaluation Task Force (CETF). The study concludes that use of non-STS transportation can help meet several important program objectives as well as reduce the total number of STS flights. It also finds, however, that reduction of Space Station-dedicated STS flights below 8 per year forces a reduction in Station crew size assuming the CETF 90 day crew stay time baseline and seriously impairs scientific utilization of the Station. Author

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

**N88-18609*#** Martin Marietta Corp., Denver, Colo.
**ORBITER TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 4: SPACE STATION ACCOMMODATIONS. REVISION 1 Final Report, Jul. 1984 - Oct. 1985**
Roger M. Randall Jul. 1987 436 p
(Contract NAS8-36108)
(NASA-CR-179293; NAS 1.26:179293; MCR-86-2601-Vol-4-Rev-1)
Avail: NTIS HC A19/MF A01 CSCL 22B

A brief summary is given of the key objectives of Task 5 of the Space Station Accommodations Concept Definition. Space station accommodations were assessed and defined for each potential candidate Space-Based OTV concept and for the composite OTV fleet. To accomplish this, the functional and physical interactions between each OTV concept and the space station were defined. Then, conceptual accommodation designs were prepared and optimized for approach and configuration. Initial space station requirements were identified, including the ability to accommodate and support evolution to maturity, and then a time-phasing of accommodations was prepared showing that evolution. In the process of developing physical and functional interactions, operational requirements were defined, together with associated timelines. In that the crew complement is subject to limitations, the operational requirements derivation is biased toward automation wherever possible. For each candidate Ground-Based OTV concept, operating in conjunction with the space station, the above process was repeated. Author

**N88-18610*#** Martin Marietta Corp., Denver, Colo.
**ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 4, APPENDIX A: SPACE STATION ACCOMMODATIONS. REVISION 1 Final Report, Jul. 1984 - Oct. 1985**
Roger M. Randall Jul. 1987 305 p
(Contract NAS8-36108)
(NASA-CR-179294; NAS 1.26:179294;
MCR-86-2601-Vol-4-App-A-Rev-1) Avail: NTIS HC A14/MF A01 CSCL 22B

Orbit Transfer Vehicle (OTV) processing at the space station is divided into two major categories: OTV processing and assembly operations, and support operations. These categories are further subdivided into major functional areas to allow development of detailed OTV processing procedures and timelines. These procedures and timelines are used to derive the specific space station accommodations necessary to support OTV activities. The overall objective is to limit impact on OTV processing requirements on space station operations, involvement of crew, and associated crew training and skill requirements. The operational concept maximizes use of automated and robotic systems to perform all required OTV servicing and maintenance tasks. Only potentially critical activities would require direct crew involvement or supervision. EVA operations are considered to be strictly contingency back-up to failure of the automated and robotic systems, with the exception of the initial assembly of Space-Based OTV accommodations at the space station, which will require manned involvement. Author

**N88-18611*#** Chrysler Corp., New Orleans, La. Engineering Office.
**SPACE SHUTTLE PHASE B WIND TUNNEL TEST DATABASE Summary Report**
J. L. Glynn and D. E. Poucher Mar. 1988 289 p
(Contract NAS1-18276)
(NASA-CR-4121; NAS 1.26:4121; DMS-DB-01) Avail: NTIS HC A13/MF A01 CSCL 22B

Archived wind tunnel test data are available for flyback booster or other alternate recoverable configurations as well as reusable orbiters studied during initial development (Phase B) of the Space Shuttle. Considerable wind tunnel data were acquired by competing contractors and NASA centers for an extensive variety of configurations with an array of wing and body planforms. This wind tunnel test data has been compiled into a database and are available for application to current winged flyback or recoverable booster aerodynamic studies. The Space Shuttle Phase B Wind Tunnel Database is structured by vehicle component and configuration type. Basic components include the booster, the orbiter and the launch vehicle. Booster configuration types include straight and delta wings, canard, cylindrical, retro-glide and twin body. Orbiter configuration types include straight and delta wings, lifting body, drop tanks and double delta wings. Author

**N88-18612*#** National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
**SPACECRAFT FIRE DETECTION AND EXTINGUISHMENT: A BIBLIOGRAPHY Final Report**
Nora H. Jason Feb. 1988 64 p
(NASA Order C-32000-J)
(NASA-CR-180880; NAS 1.26:180880; NBSIR-88-3712) Avail: NTIS HC A04/MF A01 CSCL 22B

Pertinent fire detection and extinguishment references have been identified to further the knowledge of spacecraft fire safety. To broaden the scope of the bibliography, other unusual environments, e.g., aircraft, submarine, ship, have been included. In addition, for a more comprehensive view of the spacecraft fire safety problem, selected subjects are included, e.g., materials flammability, smoke, human behavior. The references will provide the researcher with access to state-of-the-art and historic works. Selected references from the 1960's have been included, but the emphasis is on references published from 1975 to 1987. The references are arranged by very broad categories. Often a paper will cover more than one topic, but for the purposes of this bibliography it will be cited only once. Author

# 17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

**N88-18787*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FRAME SYNCHRONIZATION PERFORMANCE AND ANALYSIS**
C. S. R. Aguilera, L. Swanson, and G. H. Pitt, III *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 110-116 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09F

**N88-18788*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A NOISE-ADDING RADIOMETER FOR THE PARKES ANTENNA**
T. J. Brunzie *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 117-122 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09F

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

**N88-18613#** Naval Postgraduate School, Monterey, Calif.
**INVESTIGATION OF THE SPIN STABILITY OF THE NPS (NAVAL POSTGRADUATE SCHOOL) MINI-SATELLITE (ORION) Progress Report, 5 Jul. - 30 Sep. 1987**
Kilsoo S. Kim and Young S. Shin 4 Dec. 1987 29 p
(Contract MIPR-F62400-87-0004)
(AD-A187781; NPS-69-87-011) Avail: NTIS HC A03/MF A01 CSCL 22A

A preliminary design of the Navy Postgraduate School Mini-Satellite consists of a long cylindrical body and four radial booms and uses the single spin stabilization scheme for its attitude control. Stability conditions between design parameters for simple spinning motions of the satellite in space are investigated by applying Liapunov stability theory and using the natural modes as the admissible functions of internal coordinates. The stability diagram from this study shows that the internal stability conditions due to the flexibility of booms limit the angular velocity range of simple spins while the Maximum Axis Rule limit the minimum lengths of booms. GRA

**N88-18614#** Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
**COLUMBUS FEASIBILITY STUDIES. VOLUME 4: INTEGRATION, TEST, AND OPERATIONS Final Report**
Bonn, West Germany Bundesministerium fuer Forschung und Technologie 1986 379 p Sponsored by Bundesministerium fuer Forschung und Technologie
(ETN-88-90576) Avail: NTIS HC A17/MF A01

A manufacturing, integration, and test plan for the Columbus space station subsystems is outlined. An operations scenario which identifies typical activities on ground and in orbit is presented. ESA

**N88-18615*#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
**APOLLO LIGHTCRAFT PROJECT**
Leik N. Myrabo, John S. Blandino, Chris A. Borkowski, David P. Cross, Scott R. Frazier, Stephen C. Hill, Todd J. Mitty, Jeffrey P. Moder, Ciro Morales, and Gregory A. Nyberg et al. 1987 98 p Presented at the NASA/USRA Advanced Design Program 3rd Annual Summer Conference, Washington, D.C., 17-19 Jun. 1987
(Grant NGT-80001)
(NASA-CR-182575; NAS 1.26:182575) Avail: NTIS HC A05/MF A01 CSCL 22B

The detailed design of a beam-powered transatmospheric vehicle, the Apollo Lightcraft, was selected as the project for the design course. The principal goal is to reduce the LEO payload delivery cost by at least three orders of magnitude below the Space Shuttle Orbiter in the post 2020 era. The completely reusable, single-stage-to-orbit shuttlecraft will take off and land vertically, and have a reentry heat shield integrated with its lower surface. At appropriate points along the launch trajectory, the combined cycle propulsion system will transition through three or four airbreathing modes, and finally use a pure rocket mode for orbital insertion. The objective for the Spring semester propulsion source was to design and perform a detailed theoretical analysis on an advanced combined-cycle engine suitable for the Apollo Lightcraft. The preliminary theoretical analysis of this combined-cycle engine is now completed, and the acceleration performance along representative orbital trajectories was simulated. The total round trip cost is $3430 or $686 per person. This represents a payload delivery cost of $3.11/lb, which is a factor of 1000 below the STS. The Apollo Lightcraft concept is now ready for a more detailed investigation during the Fall semester Transatmosphere Vehicle Design course. Author

**N88-18616#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**CONSTRUCTION ASPECTS OF TESTBEDS FOR ATTITUDE CONTROL SYSTEMS SIMULATION OF ARTIFICIAL SATELLITES [ASPECTOS CONSTRUTIVOS DE BANCADAS PARA SIMULACAO DE SISTEMAS DE CONTROLE DE ATITUDE DE SATELITES ARTIFICAIS]**
Agenor T. Fleury, Petronio NdeSouza, and L. Victor C. Cardieri Aug. 1987 6 p In PORTUGUESE; ENGLISH summary Presented at the 9th Brazilian Congress of Mechanical Engineering, Florianopolis, Santa Catarina, 7-11 Dec. 1987
(INPE-4283-PRE/1155) Avail: NTIS HC A02/MF A01

This work presents the basic aspects concerning the construction of two test beds for satellite Attitude and Orbit Control Systems (AOCS) hardware-in-the-loop tests. The main goal to be reached with these test beds is the fast accomplishment of laboratory results in the various phases of an AOCS development, from its initial conceptual definition to a prequalification phase. The central equipment of these test beds consists of a one-degree-of-freedom air bearing table and a two-degree-of-freedom servo rate table. Various AOCS components such as reaction wheels, cold gas jet propulsion system, telemetry/telecommand system and celestial simulators were also developed at INPE. The designs of the test beds as integrated equipments are presented. The main performance parameters and associated experimental results are presented and discussed as well. Author

**N88-18617#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**TABLE WITH AEROSTATIC BEARINGS FOR SIMULATION IN ONE DEGREE OF FREEDOM OF ATTITUDE CONTROL SYSTEMS OF ARTIFICIAL SATELLITES M.S. Thesis, Jun. 1986 [MESA COM MANCAIS AEROSTATICOS PARA SIMULACAO EM UM GRAU DE LIBERDADE DE SISTEMAS DE CONTROLE DE ATITUDE DE SATELITES ARTIFICIAIS]**
Luiz Victor Carone Cardieri Aug. 1987 148 p In PORTUGUESE; ENGLISH summary
(INPE-4320-TDL/287) Avail: NTIS HC A07/MF A01

For a dynamic simulation in one degree of freedom of complete attitude control systems of artificial satellites, one utilizes a platform which allows one to rotate this system with high accuracy, subjecting it to low disturbance torques (on the order of 10,000 N.m), comparable to the ones to which the satellite will be submitted when in orbit. This characteristic can be reached with the use of aerostatic bearings with good dynamic stability. This work presents the design and construction of this simulation table, with emphasis on modeling and dimensioning of the bearings for minimal disturbance. In addition, some characteristics of the table are experimentally verified (load capacity, axial stiffness, axis accuracy and disturbance torque) and the necessary instrumentation is chosen in order to proceed with the autonomous simulation, that is, angular position and velocity measurement system, power supply, and data transmission and receiving station. Author

**N88-18618*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**STRUCTURAL ANALYSIS OF THE SPACE SHUTTLE SOLID ROCKET BOOSTER/EXTERNAL TANK ATTACH RING**
John T. Dorsey Jan. 1988 32 p
(NASA-TM-100510; NAS 1.15:100510) Avail: NTIS HC A03/MF A01 CSCL 22B

An External Tank (ET) attach ring is used in the Space Shuttle System to transfer lateral loads between the ET and the Solid Rocket Booster (SRB). Following the Challenger (51-L) accident, the flight performance of the ET attach ring was reviewed, and negative margins of safety and failed bolts in the attach ring were subsequently identified. The analyses described in this report were performed in order to understand the existing ET attach ring structural response to motor case internal pressurization as well as to aid in an ET attach ring redesign effort undertaken by NASA LaRC. The finite element model as well as the results from linear and nonlinear static structural analyses are described. Author

**N88-18619*#** Smith Advanced Technology, Inc., Huntsville, Ala.
**SPACE STATION OPERATING SYSTEM STUDY Summary Report**
Albert E. Horn and Morris C. Harwell Feb. 1988 175 p
(Contract NAS8-36462)
(NASA-CR-179308; NAS 1.26:179308; SAT88-0002) Avail: NTIS HC A08/MF A01 CSCL 22B

The current phase of the Space Station Operating System study is based on the analysis, evaluation, and comparison of the operating systems implemented on the computer systems and workstations in the software development laboratory. Primary emphasis has been placed on the DEC MicroVMS operating system as implemented on the MicroVax II computer, with comparative analysis of the SUN UNIX system on the SUN 3/260 workstation computer, and to a limited extent, the IBM PC/AT microcomputer running PC-DOS. Some benchmark development and testing was also done for the Motorola MC68010 (VM03 system) before the system was taken from the laboratory. These systems were studied with the objective of determining their capability to support Space Station software development requirements, specifically for multi-tasking and real-time applications. The methodology utilized consisted of development, execution, and analysis of benchmark programs and test software, and the experimentation and analysis of specific features of the system or compilers in the study. Author

**N88-18620*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**EFFECT OF TRANSITION AERODYNAMICS ON AEROASSIST FLIGHT EXPERIMENT TRAJECTORIES**
Elizabeth A. Minier and William T. Suit Jan. 1988 32 p
(NASA-TM-100546; NAS 1.15:100546) Avail: NTIS HC A03/MF A01 CSCL 22A

Various transition methods are used here to study the viscous effects encountered in low density, hypersonic flight, through the transition from free molecular to continuum flow. Methods utilizing Viking data, Shuttle Orbiter data, a Potter number parameter, and a Shock Reynolds number were implemented in the Program to Optimize Simulated Trajectories (POST). Simulations of the Aeroassist Flight Experiment (AFE) using open loop guidance were used to assess the aerodynamic performance of the vehicle. A bank angle was found for each transition method that would result in a 200 nautical-mile apogee. Once this was done, the open loop guidance was replaced by the proposed guidance algorithm for the AFE. Simulations were again conducted using that guidance and the different transitions for comparison. For the gains used, the guidance system showed some sensitivity in apogee altitude to the transition method assumed, but the guidance was able to successfully complete the mission. Author

**N88-18952*#** General Electric Co., Philadelphia, Pa.
**DESIGN AND DYNAMIC TESTING OF AN INSTRUMENTED SPACECRAFT COMPONENT**
Thomas J. Dwyer *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 93-102 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 22B

**N88-18955*#** General Electric Co., Philadelphia, Pa. Astro Space Div.
**SPACECRAFT REDESIGN TO REDUCE MICROPHONIC RESPONSE OF A VCO COMPONENT**
J. C. Strain and S. Mittal *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 167-183 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 22B

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

**N88-18621#** Naval Postgraduate School, Monterey, Calif.
**MEASUREMENTS OF PARTICULATES IN SOLID PROPELLANT ROCKET MOTORS Final Report, Oct. 1982 - Dec. 1986**
T. D. Edwards, R. K. Harris, K. G. Horton, M. G. Keith, and A. Kertadidjaja Oct. 1987 96 p
(Contract F04611-83-X-0010; AF Proj. 5730)
(AD-A187777; AFAL-TR-87-029) Avail: NTIS HC A05/MF A01 CSCL 21B

An investigation has been conducted to develop techniques for obtaining quantitative data that can be used to relate solid rocket propellant composition and operating environment to the behavior of solid particulates within the grain port and exhaust nozzle. The techniques employed are high speed motion pictures of propellant strand burners and slab burners in a cross-flow environment, SEM analysis of post-fire residue (strand, slab, and motor), determination of D32 across the exhaust nozzle using measurements of scattered laser light, and holograms of burning propellant strands, slabs, and motors. In addition, techniques are being developed for automatic retrieval of particular size distributions from holograms taken of the combustion of solid propellants. Results are presented on: (1) the measurement of particular size changes across an exhaust nozzle, (2) holograms obtained at the nozzle entrance, and (3) automatic data retrieval from holograms. GRA

**N88-18622*#** Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
**HIGH PERFORMANCE SOLID ROCKET MOTOR (SRM) SUBMERGED NOZZLE/COMBUSTION CAVITY FLOWFIELD ASSESSMENT Final Report**
J. A. Freeman, J. S. Chan, J. E. Murph, and K. E. Xiques 22 Dec. 1987 57 p
(Contract NAS8-35980)
(NASA-CR-179307; NAS 1.26:179307; LMSC-HEC-TR-F225727)
Avail: NTIS HC A04/MF A01 CSCL 21H

Two and three dimensional internal flowfield solutions for critical points in the Space Shuttle solid rocket booster burn time were

developed using the Lockheed Huntsville GIM/PAID Navier-Stokes solvers. These perfect gas, viscous solutions for the high performance motor characterize the flow in the aft segment and nozzle of the booster. Two dimensional axisymmetric solutions were developed at t = 20 and t = 85 sec motor burn times. The t = 85 sec solution indicates that the aft segment forward inhibitor stub produces vortices with are shed and convected downwards. A three dimensional 3.5 deg gimbaled nozzle flowfield solution was developed for the aft segment and nozzle at t = 9 sec motor burn time. This perfect gas, viscous analysis, provided a steady state solution for the core region and the flow through the nozzle, but indicated that unsteady flow exists in the region under the nozzle nose and near the flexible boot and nozzle/case joint. The flow in the nozzle/case joint region is characterized by low magnitude pressure waves which travel in the circumferential direction. From the two and three dimensional flowfield calculations presented it can be concluded that there is no evidence from these results that steady state gas dynamics is the primary mechanism resulting in the nozzle pocketing erosion experienced on SRM nozzles 8A or 17B. The steady state flowfield results indicate pocketing erosion is not directly initiated by a steady state gas dynamics phenomenon. Author

**N88-18623#** General Accounting Office, Washington, D. C. National Security and International Affairs Div.
**NASA (NATIONAL AERONAUTICS AND SPACE ADMINISTRATION) PROCUREMENT: THE 1973 SPACE SHUTTLE SOLID ROCKET MOTOR CONTRACTOR SELECTION**
Sep. 1987 22 p
(PB88-135264; GAO/NSIAD-87-215; B-227523) Avail: NTIS HC A03/MF A01 CSCL 21H

Certain circumstances surrounding the National Aeronautics and Space Administration's (NASA) 1973 shuttle solid rocket booster motor source selection are evaluated. Specifically, addressed are the following three questions: Did NASA's reply to bid protest decision on the 1973 source selection comply with application procurement regulations; Did NASA staff responsible for the source selection violate Executive Order 11222, which provides standards for federal employees to follow in avoiding conflicts of interest; and Did the membership of NASA's Source Evaluation Board for the solid rocket booster motor comply with the Federal Advisory Committee Act. Author

# 23 CHEMISTRY AND MATERIALS (GENERAL)

**N88-18624#** Chemical Research and Development Center, Aberdeen Proving Ground, Md.
**METHOD FOR SAMPLING OF METHYL SALICYLATE VAPOR IN AIR USING PASSIVATED STAINLESS STEEL SYRINGES AND ANALYSIS BY GAS CHROMATOGRAPHY Technical Report, Jan. - Apr. 1986**
Amnon Birenzvige and Joseph P. Krasnec Oct. 1987 10 p
(AD-A187838; CRDEC-TR-88007) Avail: NTIS HC A02/MF A01 CSCL 07C

At the present time, the only available method for sampling organic vapor content in the air is a bubble collection followed by a gas chromatographic or spectroscopic analysis. This methodology, however, is limited to a medium-to-high vapor concentration range and medium-to-long sampling time. This report describes a study to extend the sampling range to short time periods (orders of few minutes). GRA

# 24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

**N88-18625#** Akron Univ., Ohio. Inst. of Polymer Science.
**CAVITATION IN MODEL ELASTOMERIC COMPOSITES**
K. Cho and A. N. Gent Oct. 1987 31 p
(Contract N00014-85-K-0222)
(AD-A187401; TR-11) Avail: NTIS HC A03/MF A01 CSCL 11D

Layers of transparent silicone rubber were bonded between two steel spheres or between two parallel steel cylinders, to make simple mechanical models of particle-filled and fiber reinforced elastomers. When the steel end-pieces were pulled apart, visible cavities appeared suddenly in the rubber layer between them, at well-defined tensile loads and displacements. The critical conditions for cavity formation are shown to be in good agreement with a theoretical criterion for the unbounded elastic expansion of a microscopic precursor void within the rubber: that the local triaxial tensile stress attains of value of 5E/6, where E is Young's modulus for the rubber. When the rubber layer was extremely thin, however, less than about 5 per cent of the steel end piece diameter, then the stress required to form a cavity was greater than this, and it increased rapidly as the rubber thickness was reduced further. GRA

**N88-18626#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
**ON DELAMINATION OF (+ OR - THETA SUB m/90 SUB n/2) SUB s LAMINATES SUBJECT TO TENSILE LOADING Final Technical Report, Mar. 1983 - Jan. 1986**
R. S. Sandhu and G. P. Sendeckyj Jul. 1987 149 p
(AD-A188095; AFWAL-TR-87-3058) Avail: NTIS HC A07/MF A01 CSCL 11D

Delamination initiation investigations of symmetric laminates consisting of angle ply and 90-degree plies were conducted. Five criteria were used to determine delamination initiation for a given set m and n of angle plies and 90 degree plies. In the criteria one and two, delamination moment rates (delamination moment coefficients or DMC) relative to the applied average axial stress and strain in laminates with uncracked 90 degree plies, were maximized. The same approach was used in the criteria three and four except that the laminates had cracked 90 degree plies. The fifth criterion was based upon establishing the maximum mismatch of Poisson's ratios of angle plies and 90 degree plies. The expressions derived on the basis of the five criteria were numerically evaluated. The results of these studies indicated that the laminates designed on the basis of the fifth criterion, namely, maximum mismatch of Poisson's ratios of angle plies and 90-degree plies had the minimum tendency to delaminate. data, Acoustic emission. GRA

**N88-18627*#** Washington Univ., St. Louis, Mo. Dept. of Physics.
**QUANTITATIVE NON-DESTRUCTIVE EVALUATION OF POROUS COMPOSITE MATERIALS BASED ON ULTRASONIC WAVE PROPAGATION Semiannual Progress Report, 15 Sep. 1987 - 14 Mar. 1988**
James G. Miller Mar. 1988 29 p
(Grant NsG-1601)
(NASA-CR-182544; NAS 1.26:182544) Avail: NTIS HC A03/MF A01 CSCL 11D

Two complementary ultrasonic techniques for characterizing porosity in fiber-reinforced composite laminates are evaluated. Five uniaxial graphite-fiber/epoxy-matrix composites having a range of 1 to 8 percent volume fraction of solid glass inclusions to model porosity were investigated. In one technique, signal loss was measured in transmission mode and slope of attenuation, obtained from the first order coefficient of a two-parameter polynomial fit about the center frequency of the useful bandwidth, was used as the ultrasonic parameter to characterize the porosity. The results of these transmission mode measurements displayed a good

correlation between the volume fraction of porosity and the slope of attenuation. Integrated polar backscatter was used as a second ultrasonic parameter for the characterization of the porosity in these samples. A single transducer insonified the samples and measured the resulting backscatter at a polar angle of 30 deg with respect to the normal of the sample surface with the azimuthal angles centered at 0 deg with respect to the fiber orientation (i.e., along the fibers). Integrated polar backscatter also displayed good correlation with the volume fraction of porosity. Author

**N88-18628*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**CERAMIC-CERAMIC SHELL TILE THERMAL PROTECTION SYSTEM AND METHOD THEREOF Patent**

Salvatore R. Riccitiello, inventor (to NASA), Marnell Smith, inventor (to NASA), Howard E. Goldstein, inventor (to NASA), and Norman B. Zimmerman, inventor (to NASA) 14 May 1986 31 p Filed 14 May 1986 Supersedes N87-14442 (01 - 06, p 740)
(NASA-Case-ARC-11641-1; NAS 1.71:ARC-11641-1; US-Patent-4,713,275; US-Patent-Appl-SN-862925; US-Patent-Class-428-76; US-Patent-Class-428-44; US-Patent-Class-428-74; US-Patent-Class-428-920; US-Patent-Class-244-158-A; US-Patent-Class-244-117-A) Avail: US Patent and Trademark Office CSCL 11D

A ceramic reusable, externally applied composite thermal protection system (TPS) is proposed. The system functions by utilizing a ceramic/ceramic upper shell structure which effectively separates its primary functions as a thermal insulator and as a load carrier to transmit loads to the cold structure. The composite tile system also prevents impact damage to the atmospheric entry vehicle thermal protection system. The composite tile comprises a structurally strong upper ceramic/ceramic shell manufactured from ceramic fibers and ceramic matrix meeting the thermal and structural requirements of a tile used on a re-entry aerospace vehicle. In addition, a lightweight high temperature ceramic lower temperature base tile is used. The upper shell and lower tile are attached by means effective to withstand the extreme temperatures (3000 to 3200F) and stress conditions. The composite tile may include one or more layers of variable density rigid or flexible thermal insulation. The assembly of the overall tile is facilitated by two or more locking mechanisms on opposing sides of the overall tile assembly. The assembly may occur subsequent to the installation of the lower shell tile on the spacecraft structural skin. Official Gazette of the U.S. Patent and Trademark Office

**N88-18629#** Lawrence Livermore National Lab., Calif.

**COMPOSITION AND THICKNESS OF MULTILAYER FOILS USING MeV ION-BEAM TECHNIQUES**

R. G. Musket Nov. 1987 9 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-48)
(DE88-004360; UCRL-97189; CONF-880110-4) Avail: NTIS HC A02/MF A01

Characterization of both the composition and thickness of a variety of carbon and carbon-metal multilayer foils has been accomplished using simultaneous ion backscattering (RBS or BS) and particle-induced X-ray emission (PIXE). The quantitative, non-destructive measurements were made on foils with total carbon thicknesses of 96 to 460 nm and total metallic thicknesses of 14 to 260 nm. Foils with the following primary metals have been examined: titanium, chromium, nickel, copper, thorium, and uranium. The PIXE results for X-ray energies above 200 eV permitted unambiguous interpretation of the backscattering results. For the free-standing foils, the quantities and depth distributions of carbon, the primary metal, and impurities, including oxygen, were determined with a depth resolution of tens of nanometers. The foils were analyzed with either protons or helium ions. Two foils were analyzed using both protons and helium ions; the quantitative evaluations of the carbon and primary metal were within seven percent for the carbon and three percent for the metal, independent of the probing ion. DOE

**N88-18630#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**COLLOQUIUM ON DAMAGE MECHANICS OF GRAPHITE/EPOXY LAMINATES DURING FATIGUE**

Jun. 1987 250 p In GERMAN; ENGLISH summary Colloquium held in Brunswick, Fed. Republic of Germany, 2 Jul. 1987 Report will also be announced as translation (ESA-TT-1093)
(DFVLR-Mitt-87-08; ISSN-0176-7739; ETN-88-91378) Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

The influence of different parameters on the development of damage and on the properties of carbon fiber reinforced plastics (CFRP) was investigated. The initiation and propagation of damage in notched unidirectional and multidirectional carbon fiber reinforced epoxy resin laminates were investigated. Damage mechanisms in woven laminates under static and cyclic loading were studied. Measurement results concerning the safe life history of cyclic loaded carbon fiber reinforced composite materials were statistically analyzed. Damage mechanisms in CFRP riveted joints were investigated. The growth of delaminations in CFR laminated composites, and the final damage state were quantitatively described. For individual titles, see N88-18631 through N88-18637.

**N88-18631#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**DAMAGE MECHANICS OF FIBER REINFORCED PLASTICS: A GENERAL VIEW**

Rudolf Prinz *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 9-27 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)
Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

Failure mechanisms in composite laminates are discussed. Composite laminates can sustain many cracks before ultimate failure. Damage in composites can be breaks, resin cracks, interfacial debonds, and delaminations between the single laminate layers. The processes of damage in composite laminates under static and fatigue loading are described. The fracture process involves a sequential accumulation of damage, in the form of matrix-dominated transverse and longitudinal cracking and delamination. ESA

**N88-18632#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**INFLUENCE OF DIFFERENT PARAMETERS ON DAMAGE DEVELOPMENT**

Hans Christian Goetting *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 29-61 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)
Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

A test program was performed to investigate the influence of several parameters on the damage development and the fatigue properties of carbon fiber reinforced plastics. The development of approximate measuring techniques is discussed. The effects of the laminate stacking sequence, fatigue loading conditions, and environmental conditions such as temperature and/or moisture were determined. The results provide a basis for a better understanding of the main damage mechanisms and their influence on fatigue life and reliability of carbon fiber reinforced plastics. ESA

**N88-18633#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**INITIATION AND PROPAGATION OF DAMAGE IN NOTCHED UNIDIRECTIONAL AND MULTIDIRECTIONAL CFRE RESIN LAMINATES**

Ludwig Kirschke *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 63-104 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)

Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

Notched laminates made of carbon fiber reinforced epoxy resins were subjected to quasi-static stress tests and fatigue tests on unidirectional on-axis and off-axis specimens, and multidirectional specimens containing either two symmetric notches at the edges or a central hole. During loading of the specimens notch-opening displacements, crack lengths, local strains, and specimen elongations were measured. The state of damage of the specimens was analyzed by X-ray, ultrasonic C-scan, and raster electron microscopy. Based on the test results, parameters that characterize the state of damage were determined and a general understanding of crack initiation and damage development was obtained. The test data were used for a finite element calculation leading to the evaluation of energy release rate and stress intensity factors.

ESA

**N88-18634#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**DAMAGE INITIATION AND GROWTH IN SATEEN LAMINATES UNDER STATIC AND CYCLIC LOADING**

Klaus Schmidt *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 105-133 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)

Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

The mechanical properties and the damage mechanisms of a laminate with four layers and an asymmetric stacking sequence were investigated. The laminate was made of eight-end sateen weave prepregs. Static tests, tension-tension, and tension-compression fatigue tests were performed. The in-plane shear properties were determined by loading the material in a rail shear apparatus. The damage initiation and growth up to failure were observed by an optical microscope and other nondestructive test methods such as X-ray radiography and ultrasonic C-scans. The value of the stress or the number of cycles for which the first transverse cracks or the first buckling of fibers were obtained was recorded.

ESA

**N88-18635#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**STATISTICAL EVALUATION OF EXPERIMENTAL RESULTS FROM FATIGUE STRENGTH TESTS ON CFRP COMPOSITE MATERIALS**

Lutz vonBonin *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 135-188 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)

Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

Measurement results concerning the safe life history of cyclic loaded CFRP-composite materials were statistically analyzed. The results yield the statistical frequency distribution and a resultant failure rate. Comparison with appropriate types of distribution shows whether the number of cycles to failure correlates well with fracture probability. The confidence in statements concerning rate of failure, based on the frequency distribution of measured data, depends strongly on sample number and variance of the distribution. Even small variances, together with small sample numbers, deform the confidence limits so strongly that the resulting predictions on the failure characteristics become useless. However, there is no use in expanding the sample number beyond certain limits, if the variance cannot be reduced simultaneously. Calculations show that 10 to 12 samples per test series is sufficient if a constant variance is assured.

ESA

**N88-18636#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**DAMAGE MECHANISMS OF CFRP RIVETED JOINTS** c39

Dirk Wetzel *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 189-209 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)

Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

The behavior of carbon epoxy composite materials joined by rivets was studied in order to evaluate the design parameters under different climatic conditions. Static and quasi-static loading tests were performed at room temperature and at 70 C, and a relative humidity of 40 percent. The effect of fiber material, fabric, and laminate were determined for different rivet diameters, layer geometry, fiber orientation, and laminate thickness. It is shown that a riveted joint loses part of its strength due to local deformation of the rivet.

ESA

**N88-18637#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.

**DAMAGE MECHANISMS AND FATIGUE LIFE PREDICTION OF GRAPHITE/EPOXY LAMINATES**

Rudolf Prinz *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 211-246 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)

Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

The growth of delaminations in un-notched and notched carbon fiber reinforced laminated composites and the final damage state are quantitatively described. Fatigue tests were performed and an analytical model for the development of delaminations which permits the estimation of the number of loading cycles up to buckling was developed. Delaminations between composite layers can result from interlaminate stresses developing at the stress-free edges or discontinuities like holes, cut fibers, matrix cracks, or impact damage. Under cyclic loading, delaminations can grow up to the final damage state, where the delaminated sublaminate starts to buckle.

ESA

**N88-18638** Virginia Polytechnic Inst. and State Univ., Blacksburg.

**A STUDY OF THE MECHANICAL BEHAVIOR OF A 2-D CARBON-CARBON COMPOSITE Ph.D. Thesis**

William Byron Avery 1987 295 p

Avail: Univ. Microfilms Order No. DA8725104

The out-of-plane fracture of a 2-D carbon-carbon composite was observed and characterized and an understanding was gained of the factors influencing the stress distribution in such a laminate. The experimental portion consisted of performing an out-of-plane tensile test in a scanning electron microscope and determining the modes of failure. Failure was found to be interlaminar, with cracks propagating along the fiber-matrix interface. Finite element analyses of a two-ply carbon-carbon composite under in-plane, out-of-plane, and thermal loading were performed. Stress distributions were studied as a function of stacking sequence, undulation aspect ratio, and undulation offset ratio. The results are given and briefly discussed. An elasticity solution was utilized to analyze an orthotropic fiber in an isotropic matrix under uniform thermal load. The analysis reveals that the stress distributions in the fiber are singular when the radial stiffness is greater than the hoop stiffness.

Dissert. Abstr.

**N88-18639** Northwestern Univ., Evanston, Ill.
**BACKSCATTER FROM FLAWS IN FIBER-REINFORCED COMPOSITES Ph.D. Thesis**
Jianmin Qu 1987 156 p
Avail: Univ. Microfilms Order No. DA8723703

Wave scattering by cracks in anisotropic elastic media is examined. A slit, as well as a penny-shaped crack in a transversely isotropic solid, are considered. Fourier and Hankel transforms are employed to formulate scattering problems in terms of Fredholm integral equations. These equations are solved by an iteration scheme to yield low frequency asymptotic solutions to the stress intensity factors and the crack opening displacements. A new method of asymptotic analysis based on the integral representation for the scattered field is formulated to solve scattering by a planar crack in meterials with a more general kind of anisotropy. Detection and characterization of flaws was investigated in composite plates by ultrasonic means. A range of wavelengths was selected so that the mechanical behavior of the inhomogeneous fiber-reinforced composites could be represented by that of a homogeneous but anisotropic elastic solid. Analytical results are compared with experimental data for through-transmission tests. Good agreement was taken into account in an empirical manner. Various contributions to the backscatter amplitude are analyzed. Flaws are modeled by cracks of high aspect ratio. The irregularity caused by nonuniform spacing of fibers was taken into account by applying the Born approximation to analyze scattering by fiber clusters within the global anisotropy of the composite. Analytical results calculated based on this model for a configuration of off-normal backscattering are compared to experimental data, and good agreement is observed. Dissert. Abstr.

**N88-18640*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ETHYNYLATED AROMATICS AS HIGH TEMPERATURE MATRIX RESINS**
Frances I. Hurwitz Oct. 1986 12 p Presented at the 18th National SAMPE Technical Conference, Seattle, Wash., 7-9 Oct. 1986 Previously announced as A87-34850
(NASA-TM-89829; E-3480; NAS 1.15:89829) Avail: NTIS HC A03/MF A01 CSCL 11D

Difunctional and trifunctional arylacetylenes were used as monomers to form thermoset matrix resin composites. Composites can be hot pressed at 180 C to react 80 percent of the acetylene groups. Crosslinking is completed by postcuring at 350 C. The postcured resins are thermally stable to nominally 460 C in air. As a result of their high crosslink density, the matrix exhibits brittle failure when unaxial composites are tested in tension. Failure of both uniaxial tensile and flexural specimens occurs in shear at the fiber matrix interface. Tensile fracture stresses for 0 deg composites fabricated with 60 v/o Celion 6K graphite fiber were 827 MPa. The strain to failure was 0.5 percent. Composites fabricated with 8 harness satin Celion cloth (Fiberite 1133) and tested in tension also failed in shear at tensile stresses of 413 MPa. Author

**N88-18641*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
**INNOVATIVE DESIGN OF COMPOSITE STRUCTURES: FURTHER STUDIES IN THE USE OF A CURVILINEAR FIBER FORMAT TO IMPROVE STRUCTURAL EFFICIENCY**
Michael W. Hyer and Robert F. Charette (Maryland Univ., College Park.) Mar. 1988 33 p
(Grant NAG1-665)
(NASA-CR-182576; NAS 1.26:182576; VPI-E-88-8) Avail: NTIS HC A03/MF A01 CSCL 11D

Further studies to determine the potential for using a curvilinear fiber format in the design of composite laminates are reported. The curvilinear format is in contrast to the current practice of having the fibers aligned parallel to each other and in a straight line. The problem of a plate with a central circular hole is used as a candidate problem for this study. The study concludes that for inplane tensile loading the curvilinear format is superior. The limited results to date on compression buckling loads indicate that the curvilinear designs are poorer in resistant buckling. However, for the curvilinear design of interest, the reduction in buckling load is minimal and so overall there is a gain in considering the curvilinear design. Author

**N88-18642*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**HIGH PERFORMANCE COMPOSITES RESEARCH AT NASA-LANGLEY**
Terry L. StClair, Norman J. Johnston, and Robert M. Baucom Jan. 1988 21 p Presented at the SAE International Congress and Exposition, Detroit, Mich., 29 Feb. - 4 Mar. 1988
(NASA-TM-100518; NAS 1.15:100518) Avail: NTIS HC A03/MF A01 CSCL 11D

Barriers to the more extensive use of advanced composites in heavily loaded structures on commercial transports are discussed from a materials viewpoint. NASA-Langley matrix development activities designed to overcome these barriers are presented. These include the synthesis of processible, tough, durable matrices, the development of resin property/composite property relationships which help guide the synthesis program, and the exploitation of new processing technology to effectively combine reinforcement filament with polymer matrices. Examples of five classes of polymers being investigated as matrix resins at NASA Langley are presented, including amorphous and semicrystalline thermoplastics, lightly crosslinked thermoplastics, semi-interpenetrating networks and toughened thermosets. Relationships between neat resin modulus, resin fracture energy, interlaminar fracture energy, composite compression strength, and post-impact compression strength are shown. Powder and slurry processing techniques are discussed. Author

**N88-18643#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.
**MATRIX-FIBER STRESS TRANSFER IN COMPOSITE MATERIALS: ELASTO-PLASTIC MODEL WITH AN INTERPHASE LAYER Report, Sep. 1986 - Nov. 1987**
F. C. Lhotellier, T. C. Ward, and H. F. Brinson Dec. 1987 117 p
(Contract N00014-82-K-0185)
(PB88-136635; VPI-E-87-27; CAS/ESM-87-12) Avail: NTIS HC A06/MF A01 CSCL 11D

The matrix-fiber stress transfer in glass/epoxy composite materials was studied using analytical and experimental methods. The mathematical model that was developed calculates the stress fields in the fiber, interphase, and neighboring matrix fiber break. The scheme takes into account the elastic-plastic behavior of both the matrix and the interphase, and it includes the treatment of stress concentration near the discontinuities of the fibers. The radius of the fibers and the mechanical properties of the matrix were varied in order to validate the mathematical models. The computed values for the lengths of debonding, plastic deformation, and elastic deformation in the matrix near the fiber tip were confirmed by measurements taken under polarized light on loaded and unloaded single fiber samples. The fiber-fiber interaction was studied experimentally using dog-bone samples that contained seven fibers forming an hexagonal pattern. Author

**N88-18644#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
**AN EXPERIMENTAL AND NUMERICAL STUDY OF NOTCH SENSITIVITY OF ARALL LAMINATES**
Srinivas Prasad Kadiyala, Zafer Gurdal, and Carl T. Herakovich Feb. 1988 209 p
(CCMS-88-04) Avail: NTIS HC A10/MF A01

The notch sensitivity of ARALL (Aramid Aluminum Laminate) 2 and 3 laminates subjected to uniaxial tensile loading was investigated. An experimental program was designed to test notched 0 and 90 deg ARALL specimens with 3 different hole diameters. Unnotched specimens were tested to determine the elastic properties, including shear modulus of the ARALL laminates. Comparison of ARALL 2 and 3 laminates has shown that ARALL 3 laminates exhibit higher strength than the corresponding ARALL

2 specimens. Based on the experimental observations, a failure mechanism is proposed for notched ARALL laminates. The failure of 0 deg ARALL laminates is governed by fiber failure in the aramid/epoxy layer. Experimental results for the off-axis elastic properties are compared with the predictions from transformation equations. Finite element analysis of notched laminates was performed in order to gain a better understanding of the experimental results. A linear analysis was found to be unsuitable for predicting the complete response of ARALL laminates. A Successive Yielding Model was used for modeling the behavior of the ARALL laminates. Predictions of this model are in excellent agreement with experimental results. Author

**N88-18645#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
**ANALYSIS OF COMPOSITE LAMINATES WITH MATRIX CRACKS**
Shi-Wei Lee and Jacob Aboudi Feb. 1988 134 p
(CCMS-88-03) Avail: NTIS HC A07/MF A01

Analysis of the effects of matrix cracking on composite laminates is a well-known problem which has attracted considerable attention for the past decade. An approximate analytical solution is introduced. The subjects of primary concern are the degradation of effective laminate properties as a function of crack density and the axial stress redistribution due to the existence of matrix cracks. Results for graphite-epoxy cross-ply laminates are presented and compared to those of other approaches. Some other materials, for instance, glass/epoxy are also studied. The results and comparisons will appear where appropriate. In general, the agreement between the results of this analysis and those of other approaches, in particular, the finite element method, is good for the lower crack density. The present study shows that Poisson's ratio may be a good indicator of the degree of damage for a cracked laminate. Author

**N88-18646*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
**RADIATION AND TEMPERATURE EFFECTS ON THE TIME-DEPENDENT RESPONSE OF T300/934 GRAPHITE/EPOXY Interim Report No. 69**
Robert N. Yancey and Marek-Jerzy Pindera Mar. 1988 171 p
(Grant NAG1-343)
(NASA-CR-182603; NAS 1.26:182603; CCMS-88-02; VPI-E-88-5)
Avail: NTIS HC A08/MF A01 CSCL 11D

A time-dependent characterization study was performed on T300/934 graphite/epoxy in a simulated space environment. Creep tests on irradiated and nonirradiated graphite/epoxy and bulk resin specimens were carried out at temperatures of 72 and 250 F. Irradiated specimens were exposed to dosages of penetrating electron radiation equal to 30 years exposure at GEO-synchronous orbit. Radiation was shown to have little effect on the creep response of both the composite and bulk resin specimens at 72 F while radiation had a significant effect at 250 F. A healing process was shown to be present in the irradiated specimens where broken bonds in the epoxy due to radiation recombined over time to form cross-links in the 934 resin structure. An analytical micromechanical model was also developed to predict the viscoelastic response of fiber reinforced composite materials. The model was shown to correlate well with experimental results for linearly viscoelastic materials with relatively small creep strains. Author

**N88-18647#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
**ELASTOPLASTIC RESPONSE OF UNIDIRECTIONAL GRAPHITE/ALUMINUM UNDER COMBINED TENSION-COMPRESSION CYCLIC LOADING**
Mark Wen Yih Lin and Marek-Jerzy Pindera Feb. 1988 169 p
Sponsored by Materials Sciences Corp., Spring House, Pa. and Center for Innovative Technology, Herndon, Va.
(CCMS-88-01; VPI-E-88-03) Avail: NTIS HC A08/MF A01

A test fixture for combined tension compression cyclic testing of unidirectional composites was designed and characterized using 6061-O aluminum specimens. The elastoplastic response of graphite aluminum 15 deg off-axis and 90 deg specimens under tension compression cyclic loading was subsequently investigated at 3 temperatures, -150 F, room temperature and 250 F. The test results showed that the tensile response was predominantly elastoplastic, whereas the compressive response could not be characterized exclusively on the basis of the classical plasticity theory. Secondary dissipative mechanisms caused by inherent voids in the material's microstructure has an influence on the elastoplastic behavior in compression. At different test temperatures, the initial yield stress in tension and compression were translated in the tension direction with increasing temperature. This is believed to be caused by residual stress induced in each phase of the composite. A micromechanics model was employed to correlate the experimental and analytical results at room temperature. A semi-inverse methodology was incorporated to determine the in situ properties of the constituents. Author

**N88-18648#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Sciences.
**FINITE ELEMENT ANALYSIS OF ADHESIVELY BONDED COMPOSITE JOINTS INCLUDING GEOMETRIC NONLINEARITY, NONLINEAR VISCOELASTICITY, MOISTURE DIFFUSION AND DELAYED FAILURE Final Report, Jun. 1984 - Nov. 1987**
S. Roy and J. N. Reddy Dec. 1987 201 p
(Contract N00014-82-K-0185)
(PB88-147822; CAS/ESM-87-13; VPI-E-87-28) Avail: NTIS HC A10/MF A01 CSCL 11D

A two-dimensional finite element computational procedure was developed for the accurate analysis of the strains and stresses in adhesively bonded joints. The large displacements and rotations experienced by the adherends and the adhesive are taken into account by invoking the updated Lagrangian description of motion. The adhesive layer is modeled using Schapery's nonlinear single integral constitutive law for uniaxial and multiaxial states of stress. Effect of temperature and stress level on the viscoelastic response is taken into account by a nonlinear shift factor definition. Penetrant sorption is accounted for by a nonlinear Fickean diffusion model in which the diffusion coefficient is dependent on the penetrant concentration and the dilatational strain. A delayed failure criterion based on the Reiner-Weisenberg failure theory was also implemented in the finite element code. The applicability of the proposed models is demonstrated by several numerical examples. GRA

**N88-18649*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
**STUDY OF THE MECHANICAL BEHAVIOR OF A 2-D CARBON-CARBON COMPOSITE Interim Report No. 66**
W. B. Avery and C. T. Herakovich Aug. 1987 296 p
(Grant NAG1-343)
(NASA-CR-182594; NAS 1.26:182594; PB88-140819; CCMS-87-13; VPI-E-87-15) Avail: NTIS HC A13/MF A01 CSCL 11D

The out-of-plane fracture of a 2-D carbon-carbon composite was observed and characterized to gain an understanding of the factors influencing the stress distribution in such a laminate. Finite element analyses of a two-ply carbon-carbon composite under in-plane, out-of-plane, and thermal loading were performed. Under in-plane loading all components of stress were strong functions of geometry. Additionally, large thermal stresses were predicted. Out-of-plane tensile tests revealed that failure was interlaminar, and that cracks propagated along the fiber-matrix interface. An elasticity solution was utilized to analyze an orthotropic fiber in an isotropic matrix under uniform thermal load. The analysis reveals that the stress distributions in a transversely orthotropic fiber are radically different than those predicted assuming the fiber to be transversely isotropic. GRA

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

**N88-18650#** Oak Ridge National Lab., Tenn.
**VOID FORMATION IN SOLIDIFICATION**
Vasilios Alexiades Presented at EQUADIFF '87, Xanthi, Greece, 1 Aug. 1987 1987 Presented at EQUADIFF '87, Xanthi, Greece, 1 Aug. 1987 Prepared in cooperation with Tennessee Univ., Knoxville (For primary document see
(Contract DE-AC05-84OR-21400)
(DE88-003895; CONF-8708200-1) Avail: NTIS HC A02/MF A01

Some interesting physical and mathematical problems, arising in solidification processes when density changes are taken into account, are briefly described. DOE

**N88-18651#** Texas Univ., Austin. Dept. of Chemistry.
**ELECTRONIC AND IONIC TRANSPORT IN POLYMERS Annual Report No. 1, 15 Sep. 1986 - 30 Sep. 1987**
Martin Pomerantz, John R. Reynolds, Krishnan Rajeshwar, Dennis S. Marynick, and Timothy D. Shaffer 30 Sep. 1987 6 p
(Contract N00014-86-K-0769)
(AD-A187253) Avail: NTIS HC A02/MF A01 CSCL 07F

The synthesis and study of electrically conducting polymers, particularly polyheterocycles, is being carried out with the ultimate goal of producing materials with a variety of electronic and ionic transport properties while, at the same time, gaining an improvement in their processibility. Polymers based on monomer systems containing a high density of attached dipoles are being developed with the goal of producing materials with elevated permittivities while retaining low loss behavior. Polymers containing phosphorus, nitrogen and organic groups in the main chain and polyether sidechains are being prepared and studied as ion conductors for possible solid electrolyte applications. The kinetics of the insulating to conductive switching process in conducting polymers is being examined including the development of techniques to probe the ionic fluxes which accompany the redox processes in the polymer films. Theoretical calculations (PRDDO and ab initio) are being used to calculate structures, conformations, spin densities, HOMO-LUMO gaps, and potential energy surfaces for a wide variety of heterocyclic monomers and oligomers and will be used to predict the site of electrochemical polymerization and to understand how various substituents affect the electronic structures of the polymers. GRA

**N88-18652#** California Inst. of Tech., Pasadena.
**ELECTRON TUNNELING MICROSCOPY Report, 1 Oct. 1986 - 30 Sep. 1987**
John D. Baldeschwieler 1 Oct. 1987 6 p
(Contract N00015-86-K-0214)
(AD-A187426) Avail: NTIS HC A02/MF A01 CSCL 07B

The high vacuum STM system at Caltech has been applied to study the surface structure of MoS2. The resolution in the plane of the surface is about 1A, while that normal to the surface is better than 0.1A. It is straightforward to distinguish two distinct atomic sites at this surface by tunneling microscopy, both in the conventional constant current variable height mode as well as in the variable current constant height mode. The top layer of M0S2 consists of a hexagonal lattice of sulphur atoms with 3.16A spacing. Below this plane is an identical lattice of Mo atoms laterally displaced so as to reduce the 6-fold S planar rotational symmetry to three-fold symmetry. The surface unit cell is diamond shaped with four atoms of one type (probably sulfur) at the corners. A single atom of the other type is centered in one triangular half of the cell and a hollow located in the other half. The variation in tunnel current through a series of cell diagonals and cell edges reveals a repeated pattern of three sites along the former and only simple sinusoidal modulation along the latter. GRA

**N88-18653#** Massachusetts Inst. of Tech., Cambridge.
**A VISCOELASTIC BEM (BOUNDARY ELEMENT METHOD) FOR MODELING OXIDATION**
Thye-Lai Tung, Jerome Connor, and Dimitri A. Antoniadis Mar. 1987 10 p
(Contract N00014-85-K-0213)
(AD-A187490) Avail: NTIS HC A02/MF A01 CSCL 07D

A viscoelastic boundary element has been developed to model the motion of silicon dioxide and silicon nitride during thermal oxidation of silicon. This technique uses Kelvin's solution reformulated according to the correspondence principle on viscoelasticity. Constant velocity loading is chosen to ensure smooth variations in displacement and stress behavior for a wide range of relaxation times. GRA

**N88-18654#** Dow Chemical Co., Midland, Mich. Thermal Research Lab.
**EVALUATION AND COMPILATION OF THERMODYNAMIC PROPERTIES OF HIGH TEMPERATURE CHEMICAL SPECIES Final Report, 20 May 1985 - 19 May 1986**
Malcolm W. Chase 13 Aug. 1987 9 p
(Contract F49620-85-C-0076)
(AD-A187509; AFOSR-87-1420TR) Avail: NTIS HC A02/MF A01 CSCL 07B

This work involves a continuing effort to provide a set of critically evaluated, internally consistent, high temperature thermochemical tables - the JANAF Thermochemical Tables. During this contract period, the chemical species studied fell into three categories - alkaline earth species, alkali metal species, and elements. The species in the alkaline metal series include the metals themselves, hydroxides, halides, oxides, sulfides, sulfates and carbonates. The species in the alkali metal series include the halides and the carbonates. The elements under study include boron and aluminum. The support information gathered for the study of these chemical species has been collected together in a concise readable form and is available upon request. The calculation of the thermodynamic functions for diatomic gases was greatly enhanced by the addition of two calculational techniques. These procedures permit a more accurate accounting of the vibrational-rotational energy levels for each electronic state, including the metastable levels just above the dissociation limit. These procedures are particularly important in those cases where the electronic potential energy curve is very shallow, i.e., diatomic beryllium. GRA

**N88-18655#** Florida Univ., Gainesville. Dept. of Chemistry.
**ATOMIC AND MOLECULAR GAS PHASE SPECTROMETRY Final Report, 1 Oct. 1985 - 30 Sep. 1987**
J. D. Winefordner 1987 34 p
(Grant AF-AFOSR-0015-86)
(AD-A187562; AFOSR-87-1581TR) Avail: NTIS HC A03/MF A01 CSCL 07B

The research involves an extensive investigation of analytical and physical aspects of gas phase spectroscopy. The goal of these studies is the development of high sensitivity, high selectivity, precise, accurate methods of analysis of elements in real samples by atomic adsorption, atomic emission, atomic fluorescence, atomic ionization, and atomic photothermal methods. The major research projects have included: evaluation of the mechanism of vaporization, atomization, excitation, and ionization of N2 molecules in the ICP; derivation of expressions to describe analytical growth curves in AFS; measurement of OH rotational population distributions in combustion flames and evaluation of the departures from thermal equilibrium; evaluation of the analytical uses of flame and furnace coherent forward scatter spectrometry using both lasers and detection methods for atomic fluorescence and atomic ionization. GRA

**N88-18656#** Emory Univ., Atlanta, Ga.
**STUDIES OF FLUORINE COMBUSTION Final Report, 8 Jan. 1986 - 31 Jul. 1987**
Myron Kaufman 3 Sep. 1987 4 p
(Grant AF-AFOSR-0220-86)

(AD-A187646; AFOSR-87-1923TR) Avail: NTIS HC A02/MF A01 CSCL 21B

This program has funded the purchase of a Coherent Inc. CW ring dye laser with intracavity doubling capability exacted by an 18 watt Ar ion laser. This laser system will be employed as a sensitive and specific probe for intermediates in the combustion of various fuels in F2. Because of their extreme exothermicity, many such reactions have considerable potential for propulsion applications. GRA

**N88-18657#** Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.

**FUELS COMBUSTION RESEARCH Annual Report, 10 Oct. 1986 - 30 Sep. 1987**

Frederick L. Dryer, Irvin Glassman, and Forman A. Williams 31 Oct. 1987 38 p

(Contract F49620-86-C-0006)

(AD-A187688; AFOSR-87-1901TR) Avail: NTIS HC A03/MF A01 CSCL 21B

After studying soot formation in normal diffusion flames, near and slightly sooting inverse diffusion flames were investigated to determine the key intermediates to soot formation. The results indirectly confirm that the initial number density of soot particles which form scale with aromatic formation just prior to soot inception. Correlations exist between a fuel's sooting tendency as measured by the Princeton smoke height experiment and the extent of aromatic formation measured in both inverse and normal diffusion flames. Work on the oxidation of the aromatics present in jet propulsion fuels continues with the major effort directed at the dialkylated benzenes. The major study concerned the oxidation of para-xylene. The results indicate oxidation of one side chain at a time before the benzene ring is attached. There is a linear decay of the fuel and the major species detected were toluene, benzene, p-tolualdehyde, p-ethyltoluene and carbon monoxide. Kinetics steps leading to these intermediates are given. Combustion property observations of isolated boron slurry droplets were extended to in-house boron/JP-10 slurries with and without surfactants. The experimental results revealed that stabilizing agents are responsible for the violent disruption of the primary slurry droplet and strongly support the previously proposed hypothesis of the formation of the impermeable shell and subsequent disruption phenomena. GRA

**N88-18658#** Naval Research Lab., Washington, D.C.

**SIMULATION OF INFRARED SPECTRA Memorandum Report, Aug. 1986 - Apr. 1987**

C. H. Douglass, R. T. Loda, and H. H. Nelson 20 Oct. 1987 88 p

(AD-A187881; NRL-MR-6077) Avail: NTIS HC A05/MF A01 CSCL 20E

Programs have been developed to simulate absorption and emission spectra of atmospheric and combustion product species. The programs use tabulated constants of the molecules of interest to calculate transition frequencies and line strengths as a function of temperature. Asymmetric rotors and linear molecules have been included. The calculated emission and absorption spectra can be compared to experimental spectra and can be used to predict spectral shifts due to isotopic substitution. Results for a variety of materials and conditions are presented. GRA

**N88-18659#** International Business Machines Corp., San Jose, Calif.

**COUPLING OF VIBRATIONAL MODES OF ADSORBATES: APPLICATION TO FIELD INDUCED SHIFTS FOR CO AND CN ON Cu(100)**

P. S. Bagus, C. J. Nelin, K. Hermann, and M. R. Philpott Nov. 1987 17 p

(Contract N00014-82-C-0583)

(AD-A187891; TR-14) Avail: NTIS HC A03/MF A01 CSCL 07D

We have studied the coupling of the metal-ligand and the intra-molecular ligand stretching vibrations for CO and CN chemisorbed on Cu(100) using potential energy surfaces obtained with ab initio cluster model wave functions. When there is no applied electric field, approximate internal coordinate modes for these vibrations and the fully coupled normal modes give essentially the same results, showing that their coupling is small. In the presence of an applied field, the coupling is important for CN. The origin of the coupling is shown to arise from the large field induced changes in the metal-ligand distance for the ionic bond between metal and CN. The present calculations also confirm the mechanism of the field induced changes in the bond lengths and vibrational frequencies for both chemisorbed CO and CN as a Stark effect. Chemical changes are shown to be small. GRA

**N88-18660#** Air Force Astronautics Lab., Edwards AFB, Calif.

**COMBUSTION MECHANISMS Final Report, Jan. 1981 - Sep. 1987**

Tim Edwards Sep. 1987 7 p

(AD-A187979; AFAL-TR-87-077) Avail: NTIS HC A02/MF A01 CSCL 21B

The Combustion Mechanism project covered a 6.5 year time period. Its general goal was to use the recently developed laser-based combustion diagnostic probes to learn more about the chemistry and physics occurring in high pressure solid propellant flames. References to published results are included. GRA

**N88-18661#** Illinois Univ., Urbana. Coordinated Science Lab.

**DEPOSITION OF DEVICE QUALITY EPITAXIAL LAYERS OF GALLIUM NITRIDE AND INDIUM NITRIDE FOR ELECTRONIC APPLICATIONS Annual Letter Report, 21 May 1986 - 1 Oct. 1987**

9 Oct. 1987 8 p

(Contract N00014-86-K-0274)

(AD-A188001; TR-2) Avail: NTIS HC A02/MF A01 CSCL 07B

The major activity scheduled for the first year of the program was the design and construction of a suitable ultra-high vacuum deposition apparatus and the initiation of shakedown experiments. The apparatus has essentially been completed and shakedown experiments are beginning. The apparatus design and the experimental plan for the shakedown experiments are described in this report. GRA

**N88-18662#** Emory Univ., Atlanta, Ga.

**COMBUSTION OF HYDROGEN AND HYDROCARBONS IN FLUORINE Annual Report, Sep. 1986 - Aug. 1987**

Myron Kaufman 15 Sep. 1987 5 p

(Grant AF-AFOSR-0196-84)

(AD-A188018; AFOSR-87-1905TR) Avail: NTIS HC A02/MF A01 CSCL 21B

In this program, low pressure flames of hydrogen and hydrocarbons burning in fluorine are studied by measuring ionization, luminescence and laser induced fluorescence of intermediates. Oscillatory and pulsing behavior are noted in these flames. Experiments are designed to establish the mechanism of CH A-state emission in oxygen free combustion. Theoretical consideration of the long time behavior of bimolecular reactions has provided a general endpoint indicator for chemiluminescent gas phase titration reactions as well as a means of measuring rate constants for reactions such as H + F combination. GRA

**N88-18663#** National Aerospace Lab., Tokyo (Japan).

**CARS MEASUREMENTS OF COMBUSTION. 2: GAS SPECIES CONCENTRATION MEASUREMENTS**

Yasuo Watanabe, Mitsuo Gomi, Kunihisa Eguchi, and Atsumu Tezaki Aug. 1987 16 p In JAPANESE; ENGLISH summary

(NAL-TR-940; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

An improved phase-match arrangement for generating broadband CARS signals was devised and applied to the detection of low concentration species in a burned gas. This arrangement was effective in eliminating nonresonant signals generated in a light path and was capable of keeping the signal levels higher than a BOXCARS arrangement. It was shown that by single-pulse measurements the lowest detection level of oxygen concentration

was possible down to 2 percent volumetric fraction. A nonresonant background suppression technique was also attempted and background-free spectra of oxygen and carbon monoxide were obtained to demonstrate the background rejection ability and the enhancement of detectivity. Author

**N88-18664*#** Eloret Corp., Sunnyvale, Calif.
**CALCULATIONS OF RATE CONSTANTS FOR THE THREE-BODY RECOMBINATION OF H2 IN THE PRESENCE OF H2**
David W. Schwenke [1988] 50 p
(Contract NCC2-443)
(NASA-CR-182548; NAS 1.26:182548) Avail: NTIS HC A03/MF A01 CSCL 07D

A new global potential energy hypersurface for H2 + H2 is constructed and quasiclassical trajectory calculations performed using the resonance complex theory and energy transfer mechanism to estimate the rate of three body recombination over the temperature range 100 to 5000 K. The new potential is a faithful representation of ab initio electron structure calculations, is unchanged under the operation of exchanging H atoms, and reproduces the accurate H3 potential as one H atom is pulled away. Included in the fitting procedure are geometries expected to be important when one H2 is near or above the dissociation limit. The dynamics calculations explicitly include the motion of all four atoms and are performed efficiently using a vectorized variable-stepsize integrator. The predicted rate constants are approximately a factor of two smaller than experimental estimates over a broad temperature range. Author

**N88-18665#** Sandia National Labs., Albuquerque, N. Mex. Electron Optics and X-ray Analysis Div.
**NBS/SANDIA/ICDD ELECTRON DIFFRACTION DATABASE**
M. J. Carr, W. F. Chambers, D. K. Melgaard, V. L. Himes, J. K. Stalick, and A. D. Mighell (National Bureau of Standards, Washington, D.C.) Dec. 1987 16 p
(Contract DE-AC04-76DP-00789)
(DE88-004635; SAND-87-1992) Avail: NTIS HC A03/MF A01

A new database containing crystallographic and chemical information designed specially for application to electron diffraction search/match and related problems has been developed. The new database was derived from two well-established X-ray diffraction databases, the JCPDS Powder Diffraction File and NBS CRYSTAL DATA, and incorporates two years of experience with an earlier version. It contains 71,142 entries, with space group and unit cell data for 59,612 of those. The availability of unit cell data not only makes the database potentially useful for automated diffraction pattern analysis, but it also facilitates the calculation of allowed reflections with d-spacings greater than 0.82A for the approx. 59,000 entries having unit cell data. These calculated d-spacings are used in the database in preference to experimental X-ray data when both are available, since experimental X-ray data sometimes omits high d-spacing data which falls at low diffraction angles. Other searchable data in this new database include space group, reduced cell edge length, and reduced cell volume. Compound and/or mineral names, formulas, and journal references are included in the output. Rudimentary search software has been written to implement a chemistry and r-spacing bit map search. With typical data, a full search through approx. 71,000 compounds takes 10 to 20 seconds on a PDP 11/23-RL02 system. DOE

**N88-18666#** Sandia National Labs., Albuquerque, N. Mex. Analytical Chemistry Div.
**S-GLASS ANALYSIS BY X-RAY SPECTROSCOPY**
Herbert S. Levine and Edward V. Thomas Sep. 1987 17 p
(Contract DE-AC04-76DP-00789)
(DE88-004636; SAND-87-2219) Avail: NTIS HC A03/MF A01

A rapid and accurate X-ray fluorescence (XRF) method for estimating concentrations of K sub 2 O, SiO sub 2, A sub 2 O sub 3, P sub 2 O sub 5, and (Li sub 2 O + B sub 2 O sub 3) in S-glass was developed based on the use of a fundamental parameters program, a set of secondary S-glass standards, and an iterative adjustment of Li sub 2 O and/or B sub 2 O sub 3 to a total unnormalized sample composition of 100 + or - 0.01 percent. Errors introduced by the use of arbitrary and nonunique values of the light element unknown concentrations at the iterative endpoint were found to be small. Results obtained for S-glass ceramic lot 84 to 132 samples using this procedure compared well with the results of a round-robin study on the same glass. A statistical study on samples from lots 84 to 132 and 84 to 133 showed good analytical precision with relative measurement errors on the order of 0.5 percent for all components. This precision allowed detection of relatively small, but significant, sample-to-sample variations in chemical composition. In addition, it was demonstrated that the quality of the standards influences the accuracy of the results. DOE

**N88-18667#** Sandia National Labs., Albuquerque, N. Mex.
**LASER-INDUCED DESORPTION DETERMINATIONS OF SURFACE DIFFUSION ON Rh(111)**
E. G. Seebauer and L. D. Schmidt 1987 13 p Presented at the LASST-ACSIS Conference on Interfacial Diffusion, New Brunswick, Canada, 18 Aug. 1987 Prepared in cooperation with Minnesota Univ., Minneapolis
(Contract DE-AC04-76DP-00789)
(DE88-005159; SAND-87-1603C; CONF-8708209-1) Avail: NTIS HC A03/MF A01

Surface diffusion of hydrogen, deuterium and CO on Rh(111) has been investigated by laser-induced thermal desorption (LITD) and compared with previous results for these species on Pt(111) and on other metals. For deuterium in the coverage range 0.02 less than theta less than 0.33, the pre-exponential factor D sub o - 8 x 10 to the -2 sq cm/sec, with a diffusion activation energy 3.7 less than E(sub diff) less than 4.3 kcal/mol. For CO, E(sub diff) = 7 kcal/mol, but D sub o rises from 10 to the -3 to 10 to the -2 sq cm/sec between theta = 0.01 and 0.40. Values of E(sub diff) on different surfaces appear to correlate with differences in heats of adsorption in different binding states which form saddle point configurations in surface diffusion. In addition, oxidation reactions on Rh and on several other transition metal surfaces may be limited to CO or H surface diffusion. DOE

**N88-18668#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
**SIMPLE RENORMALIZATION GROUP METHOD FOR CALCULATING THERMAL EQUATIONS OF STATES**
A. O. Caride and C. Tsallis 1987 21 p
(DE88-700143; CBPF-NF-018/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Renormalization-group (RG) techniques are currently used to derive relevant quantities in the vicinity of the critical point. A real-space RG procedure which directly yields the order parameter for all values of the external parameters (e.g., temperature) is presented. It is as simple as a mean-field calculation, although it provides non trivial results, which can be systematically improved. The method is successfully illustrated on the square-lattice Potts ferromagnet. The whole approach suggests that the order parameter on a hierarchical lattice is, on every site, proportional to its coordination number. DOE

**N88-18669#** Technical Research Centre of Finland, Espoo.
**MEASUREMENT OF COMBUSTION AEROSOL SIZE DISTRIBUTIONS WITH MULTISTAGE INERTIAL IMPACTORS**
E. Kauppinen and K. Larjava Feb. 1987 54 p In FINNISH
(DE88-751101; VTT-TUTK-466) Avail: NTIS (US Sales Only) HC A04/MF A01

The suspensions of particles and gases released from combustion processes are called combustion aerosols. The use of log-normal distribution functions to characterize the size distribution and methods for measuring the size of combustion aerosols are described. Mass and heavy metal size distributions of municipal waste combustion aerosols were determined. To measure combustion aerosol size distributions, basically two methods can be used. Mass, elemental and compound size distributions can be determined by using in-situ size-classifying sampling methods followed with analysis of samples. Another

method is the extraction, dilution and cooling of the sample and number size distribution measurement with aerosol size analyzers in the fine particle size range 0.01 to 2 microns. Mass, Cd, Pb and Zn size distributions of municipal waste combustion aerosols were determined in the size range 0.1 to 5 microns. Size-classified samples were collected with an in-stack cascade impactor (University of Washington Mark 5) on glass fiber filter and greased foil substrates. Mass was analyzed gravimetrically and metals by atomic absorption spectrophotometry. Differential mass and metal size distributions exhibit a clear mode in the range 0.1 to 0.5 microns. Fine particle (D(sub p) less than 2 microns) heavy metal concentrations c(sub i) (i=Cd, Pb and Zn) were found to be c(sub Cd)=0.30 plus or minus 0.20 mg/cu m, c(sub Pb)=1.0 plus or minus 0.4 mg/cu m, c(sub Zn)=7 plus or minus 5 mg/cu m, in dry gas at T = 273 K and p = 101.3 kPa. DOE

**N88-18670#** Kiel Univ. (West Germany). Mathematisch-Naturwissenschaftlichen Fakultaet.
**ELECTROCHEMICAL AND OPTICAL INVESTIGATIONS ON ION-IMPLANTED TiO2 SAMPLES Ph.D. Thesis [ELEKTROCHEMISCHE UND OPTISCHE UNTERSUCHUNGEN AN IONENIMPLANTIERTEN TiO2-PROBEN]**
Dorit Teschner 1986 214 p In GERMAN
(ETN-88-91485) Avail: NTIS HC A10/MF A01

Electrochemical and spectroscopic investigations were performed on semiconducting rutile electrodes, in contact with an aqueous electrolyte, in order to characterize TiO2, modified by ion implantation with different materials. Spectrophotometric measurements reveal the modification of the absorption characteristics of rutile due to ion implantation. Electrochemical measurements show that the photoelectrochemical behavior of the samples is determined by the implantation parameters dose, mass, and penetration depth. The reducing effect of ion implantation of TiO2 is due to radiation damage. The quantum efficiency versus implanted dose shows a maximum, verified by model calculations. The quantum efficiency of homogeneously reduced TiO2 samples decreases significantly after implantation. ESA

**N88-18671#** Institut Franco-Allemand de Recherches, St. Louis (France).
**PRODUCTION BY PYROLYSIS OF DIFFUSION PARTICLES FOR VELOCIMETRY IN SHOCK TUBES [STREUTEILCHENERZEUGUNG DURCH PYROLYSE FUER VELOZIMETERMESSUNGEN IM STROSSROHR PRODUCTION PAR PYROLYSE DE PARTICULES DIFFUSANTES POUR LA VELOCIMETRIE DANS LE TUBE A CHOC]**
G. Smeets, F. Gatau, A. George, and G. Mathieu 29 Aug. 1986 31 p In FRENCH and GERMAN
(ISL-R-119/86; ETN-88-91642) Avail: NTIS HC A03/MF A01

A method for producing particles for use in laser Doppler velocimetry is described. A gaseous hydrocarbon such as acetylene is added to the working gas. Heating of the gas by the shock provokes a pyrolysis reaction which forms a large quantity of carbon black particles. A layer of particles is deposited on the walls of the shock tube, constituting a reserve for several experiments. They diffuse uniformly through the tube after entrainement by the turbulent boundary layer. The particles follow the flow with almost no relaxation, allowing recordings with very low background noise. ESA

**N88-18672*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MASS TRANSPORT PHENOMENA BETWEEN BUBBLES AND DISSOLVED GASES IN LIQUIDS UNDER REDUCED GRAVITY CONDITIONS**
Kenneth J. DeWitt, Jonathan L. Brockwell (Union Carbide Corp., South Charleston, W.Va.), Chain-Nan Yung, An-Ti Chai, John B. McQuillen, Raymond G. Sotos, and Eric S. Neumann Jan. 1988 10 p Presented at the 26th Aerospace Sciences Meeting, Reno, Nev., 11-14 Jan. 1988; sponsored by AIAA
(NASA-TM-100273; E-3912; AIAA-88-0450; NAS 1.15:100273)
Avail: NTIS HC A02/MF A01 CSCL 07D

The experimental and analytical work that was done to establish justification and feasibility for a shuttle middeck experiment involving mass transfer between a gas bubble and a liquid is described. The experiment involves the observation and measurement of the dissolution of an isolated immobile gas bubble of specified size and composition in a thermostatted solvent liquid of known concentration in the reduced gravity environment of earth orbit. Methods to generate and deploy the bubble were successful both in normal gravity using mutually buoyant fluids and under reduced gravity conditions in the NASA Lear Jet. Initialization of the experiment with a bubble of a prescribed size and composition in a liquid of known concentration was accomplished using the concept of unstable equilibrium. Subsequent bubble dissolution or growth is obtained by a step increase or decrease in the liquid pressure. A numerical model was developed which simulates the bubble dynamics and can be used to determine molecular parameters by comparison with the experimental data. The primary objective of the experiment is the elimination of convective effects that occur in normal gravity. Author

**N88-18673** New South Wales Univ., Sydney (Australia).
**DEACTIVATION OF ALUMINA BASED CATALYSTS Abstract Only. Ph.D. Thesis**
Pinky Udaja Jul. 1986 73 p
Avail: Issuing Activity

Pure alumina and 3%wt Ni on gamma-Al2O3 (prepared from NiCl2) were annealed at temperatures in the range 850-1000 C for periods of 2-120 hours, and characterized by X-ray diffraction and by surface area measurement. A study was also made of 3%wt Co, Cu, Au, Ni (prepared from NiNO3) on gamma-Al2O3 annealed at 950 C for periods of 9-120 hours. It was found that sintering of gamma-Al2O3 occurs mainly as a result of phase transformation to alpha-Al2O3. The metal impurities studied, namely Ni, Co, Cu and Au have similar effects in enhancing the rate of sintering of gamma-Al2O3. It is proposed that the mechanism responsible for the increase in rate of sintering in the presence of metal impurities is one involving an increase in the number of new phase nucleation sites which promotes a more rapid phase transformation into alpha-Al2O3. Author

**N88-18674#** Council for Mineral Technology, Randburg (South Africa).
**REACTIONS OF SOME THIOL COLLECTORS AT NOBLE-METAL AND PYRITE ELECTRODES**
D. R. Groot Jul. 1987 21 p
(PB88-138318; MINTEK-M312; ISBN-0-86999-790-4) Avail: NTIS HC A03/MF A01 CSCL 07D

A number of techniques were used in a study of the electrochemical reactions of three thiol collectors (diethyldithiophosphate, mercaptobenzothiazole, and Reagent Z200) on noble-metal and pyrite surfaces. These include electrochemical, impedance, contact angle, and infrared spectroscopic studies. Based on the results, models for the reactions of these collectors are proposed so that predictions can be made about the effects of the conditions in flotation circuits on recoveries. Author

**N88-18675#** Utah Univ., Salt Lake City.
**PULSED LASER PHOTOTHERMAL SPECTROSCOPY OF LIQUIDS AND SOLIDS Progress Report, 30 Sep. 1986 - 30 Nov. 1987**
E. M. Eyring Nov. 1987 13 p
(Contract DE-FG02-84ER-13227)
(DE88-003839; DOE/ER-13227/4) Avail: NTIS HC A03/MF A01

A new apparatus has been created that measures the lifetimes of radiationless decay processes in liquids on time scales dropping down to a few nanoseconds. The particular novelty of the instrument lies in its capability of accurately resolving the shape of pulsed laser generated photoacoustic signals in liquids thus permitting a detailed comparison with recently developed theoretical models for their shape. The use of poly(vinylidene difluoride) piezoelectric detectors in these experiments has been compared

with photothermal beam deflection. The measurements have also been extended to the millisecond time scale by the inclusion of photothermal lens detection. A new study of luminescence in rare earth salts with a variety of inorganic dopants has also been carried out. DOE

**N88-18676#** Illinois Inst. of Tech., Chicago. Dept. of Physics.
**UHV (ULTRA-HIGH VACUUM) DOUBLE CRYSTAL MONOCHROMATOR DESIGN**
T. I. Morrison, N. C. Lien, S. M. Heald, L. S. Fareria, and J. Scrofani 1987 12 p Presented at the 5th National Synchrotron Radiation Instrumentation Conference, Madison, Wisc., 21 Jun. 1987 Prepared in cooperation with Baker Mfg. Co., Evansville, Wisc. and Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(DE88-003904; BNL-40533; CONF-870610-19) Avail: NTIS HC A03/MF A01

An ultra-high vacuum double-crystal fixed-exit X-ray monochromator has been designed and built for soft X-ray (0.8 to 8 KeV) spectroscopic studies. This unit, currently installed at the NSLS on beamline X-11B, uses two crystal carousels, each of which can hold four different crystals to allow crystal changes without opening the chamber. The incident crystal carousel, which only rotates, is water cooled to remove the incident beam heat load. The second carousel, which rotates and translates parallel to the beam axis, can be heated to equilibrate crystal temperatures. Design principles and results of preliminary tests are presented. DOE

**N88-18677#** Sandia National Labs., Albuquerque, N. Mex.
**VOLTAMMETRIC INVESTIGATION OF POROUS SILICON FOR INTEGRATED CIRCUIT APPLICATIONS**
M. J. Kelly, T. R. Guilinger, and S. S. Tsao 1987 14 p Presented at the 172nd Meeting of the Electrochemical Society, Honolulu, Hawaii, 18 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE88-004024; SAND-87-1110C-FP; CONF-871027-13-FP) Avail: NTIS HC A03/MF A01

Porous silicon is used in the fabrication of dielectrically-isolated integrated circuits. We present an electrochemical model of porous silicon formation in dilute (0.1 to 5 F) hydrofluoric acid (HF). The mechanism involves the anodic dissolution of silicon, passivation of the pore walls by SiO2, and depassivation by reaction of SiO2 with HF. Thermodynamic and kinetic analysis of the mechanism is performed by voltammetry with various HF concentrations, scan rates, and electrode rotation rates. DOE

**N88-18678#** Texas A&M Univ., College Station. Dept. of Chemistry.
**PROPERTIES OF LANTHANIDE OXIDES AS SUPPORTS FOR TRANSITION METAL CATALYSTS Progress Report, 1 May 1987 - 30 Apr. 1988**
M. P. Rosynek 1988 51 p
(Contract DE-AS05-78ER-06042)
(DE88-004520; DOE/ER-06042/8) Avail: NTIS HC A04/MF A01

The objective of this research program has been to provide an understanding of the manner in which variations in metal precursors and oxidic support materials, particularly lanthanide oxides, influence the reduction behaviors and catalytic/surface properties of dispersed non-noble Group VIII transition metals. Support materials selected for study provide appropriate variations in several important physical/chemical properties, including acid-base character and cationic multi-valency. Goals of the project have been to attain an increased understanding of the general phenomenon of support effects, and to enable correlations to be made between physical/chemical properties of support materials and the catalytic behaviors of transition metals that are dispersed on their surfaces. Our research effort has comprised the following areas of investigation: hydrocarbon conversion and surface carbon formation on dispersed nickel catalysts, reduction behaviors/catalytic properties of supported cobalt, and NH3 and CO2 adsorption onto an evacuated La2O3 surface. DOE

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N88-18679#** Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
**COST 501 PROJECT U.K.10. PART 4: THE OXIDATION OF FECRALLOY STEEL CO-EXTRUDED ONTO STRONG STEEL SUBSTRATES**
A. T. Tuson and M. J. Bennett Oct. 1986 29 p
(AERE-R-12432-Pt-4; HL86/1486-Pt-4) Avail: NTIS HC A03/MF A01

The oxidation behavior in air of Fecralloy steel overlayers co-extruded onto 2 1/4 Cr1Mo ferritic steel, type 321 stainless steel and Incoloy 800H were compared with that of the basic steel. The exposures were for extended periods up to 10 kh duration at 100 C intervals between 400 and 1000 C (800 C for the 2 1/4 Cr1Mo steel substrate). To resolve the underlying cause of the order of magnitude greater attack of the as-extruded overlayers, the nature of the respective scales formed were characterized by a range of surface analytical techniques. The importance of the physical and chemical condition of the Fecralloy steel overlayer surface resulting from the extrusion processing was established by testing overlayers from which the original as-fabricated surface layer had been machined off. Author

**N88-18680#** United Technologies Research Center, East Hartford, Conn.
**STUDY OF ADHERENT OXIDE SCALES Annual Technical Report, 28 Feb. 1986 - 30 Apr. 1987**
J. G. Smeggil and N. S. Bornstein 14 Sep. 1987 36 p
(Contract N00014-85-C-0421)
(AD-A187368; UTRC/R87-917259-1) Avail: NTIS HC A03/MF A01 CSCL 11F

Sulfur is an indigenous impurity present at tramp levels within nickel base alloys. Precipitated sulfides are identified within NiCrAl and NiCrAlY alloys. Auger studies show that sulfur segregates to free surfaces. Sulfur is identified at the critical oxide scale metal interface. The addition of sulfur as ferric sulfide to NiCrAl+Y causes the alloy to form non-protective oxide scales which readily spall. The addition of sulfur as Yteabium sulfide to NiCrAl+Y causes the normally protective oxide scale to spall. Sulfur causes the oxide scale to spall. Sulfur is present at the scale-metal interface in compounds and elemental form. Based upon the ESCA studies, the approximate steady state composition of the overall sulfur peak is 20 a/o elemental sulfur and 80 a/o sulfide. In summary, a new and different mechanism is proposed. It is proposed that the alumina scale that forms on NiCrAl alloys are quite adherent. Sulfur in the alloy segregates to and weakens the bonds at the oxide scale-metal interface. The role of the reactive materials which promote oxide scale adherence is to interact with and form stable compounds thereby decrease the migration and concentration of sulfur to the critical oxide scale-metal interface. GRA

**N88-18681#** Battelle Memorial Inst., Columbus, Ohio.
**CRACK ARREST FRACTURE TOUGHNESS OF ARMOR STEELS Final Report, 31 Jan. 1986 - 30 Jan. 1987**
E. J. Ripling Oct. 1987 64 p Prepared in cooperation with Materials Research Lab., Inc., Glenwood, Ill.
(Contract DAAG29-81-D-0100; DA Proj. 1L1-61102-AH-84)
(AD-A187711; MTL-TR-87-56; MRL-7037) Avail: NTIS HC A04/MF A01 CSCL 11F

A method for evaluating break up, or shattering and cracking may be by the use of the crack arrest fracture toughness, Ka. Use of this Ka would not be restricted to steels, but could be applied to other armor materials also. The crack arrest fracture toughness, Kia, of the two steels were shown to be different, the 4130 being tougher than 4340. The significance of this can only be ascertained by comparing these results with ballistic test data. GRA

**N88-18682#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
**THE METALLURGICAL DATABASE OF ALADIN: AN ALLOY DESIGN SYSTEM Interim Report**
I. Hulthage, M. Przystupa, M. L. Farinacci, and M. D. Rychener Aug. 1987 19 p Sponsored by Alcoa Labs., Alcoa Center, Pa.
(AD-A187724; CMU-RI-TR-87-20) Avail: NTIS HC A03/MF A01 CSCL 11F

Aladin is an expert system that aids metallurgists in the design of new aluminum alloys. Declarative structured representations in the form of schemata are used for metallurgical data and concepts. The representation is very general: the goal has been to create a representation for all knowledge about aluminum alloys and metallurgy relevant to the design process. This article gives an overview of the alloy database and describes the architecture of the microstructure database in detail. The microstructure of alloys is described by an enumeration of the types of microstructural elements present along with their characteristics. GRA

**N88-18683#** Naval Postgraduate School, Monterey, Calif.
**MICROSTRUCTURAL CHARACTERIZATION OF HSLA-100 GMA-WELDMENTS M.S. Thesis**
Kenneth D. Mickelberry Sep. 1987 69 p
(AD-A187782) Avail: NTIS HC A04/MF A01 CSCL 11F

A high strength low alloy steel, HSLA-100, is under development by the U.S. Navy. Instead of developing a new weld filler metal for this alloy it is desirable to use the already certified filler metals that are used for welding HY-100 steel. The research presented in this thesis evaluated the effect of cooling rate on the HY-100 welding consumable when used to weld HSLA-100 plate. The 800 C to 500 C cooling rate after gas metal arc welding was varied from 22 C/sec to 42 C/sec by using different plate thickness, different preheat and interpass temperatures as well as different heat inputs. Mechanical property data is reported elsewhere but summarized in this thesis. GRA

**N88-18684#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**REMOVAL OF OUT-OF-PLANE DISTORTION IN MILD STEEL PANELS USING FLAME HEATING, VOLUME 1 M.S. Thesis**
Larry L. Janca May 1987 165 p
(Contract N00228-85-G-3262)
(AD-A187802) Avail: NTIS HC A08/MF A01 CSCL 11F

The nature of distortion, the effects of welding, methods of removing distortion, and previous investigations on removing distortion in welded metal structures were discussed. A procedure for linear flame straightening panel structures, used aboard U.S. Naval ships, and the selection of parameters was then presented. The only variable during line heating was the heating flame velocity. T shaped unrestrained mild steel specimen, 1/8th and 3/16th of an inch thick, were fillet welded and then line heated to provide an angular distortion versus velocity relationship. Two panel structures (one using 1/8th of an inch thick plate, the other using 3/16th of an inch thick plate) similar to ship deck plates were fabricated and then line heated using the method and relationship determined from the T shaped specimen. The results of testing were presented in the form of distortion tables and graphs. It was found that line heating along the back side of fillet welded stiffeners was an effective way of removing out-of-plane and angular distortion. If the flame velocity was too low while flame straightening one panel, then the adjacent panels were also affected. Also, line heating parallel to the stiffeners did not remove buckling distortion. This study represents a first step in the investigation of flame straightening multi-panelled metal structures. Recommendations for additional testing using a combination of flame heating types, to remove all forms of panel structure distortions were presented. GRA

**N88-18685#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**REMOVAL OF OUT-OF-PLANE DISTORTION IN MILD STEEL PANELS USING FLAME HEATING, VOLUME 2 M.S. Thesis**
Larry L. Janca May 1987 169 p
(Contract N00228-85-G-3262)
(AD-A187803) Avail: NTIS HC A08/MF A01 CSCL 11F

This report discusses removal of out of plane distortion in mild steel panels using flame heating. Tables (Data) are presented with charts and graphs. GRA

**N88-18686#** Naval Postgraduate School, Monterey, Calif.
**MICROSTRUCTURAL CHARACTERIZATION OF THE HEAT AFFECTED ZONE OF HSLA (HIGH STRENGTH LOW ALLOY)-100 STEEL GMA (GAS METAL ARC)-WELDMENT M.S. Thesis**
Gary P. Potkay Dec. 1987 86 p
(AD-A187825) Avail: NTIS HC A05/MF A01 CSCL 11F

A high strength low alloy steel, HSLA-100, is under development by the U.S. Navy. The research presented in this thesis evaluated the effects of cooling rate on the heat affected zone (HAZ) of Gas Metal Arc Weldments (GMAW). The cooling rate at 540 C after gas metal arc welding was varied from 22 C/second to 42 C/second by using different plate thickness, different preheat and interpass temperatures as well as different heat inputs. Mechanical property data is reported elsewhere but summarized in this thesis. All welds met required strength and toughness. However, for all but the fastest cooling rate, the tensile test transverse to the weld failed in the weld metal rather than in the base metal as would be expected with HY-100 steel. No failures occurred in the HAZ which indicates that the strength of the HAZ is not a strength limiting factor. The HAZ microstructure was characterized by optical metallography, scanning and transmission electron microscopy. These microstructures were correlated with microhardness and the mechanical properties. Microconstituents of the coarse grain HAZ for all the weldments were predominately a mixture of low carbon, higher bainite and martensite. GRA

**N88-18687#** Naval Postgraduate School, Monterey, Calif.
**CORROSION PERFORMANCE OF HIGH DAMPING ALLOYS IN 3.5 PERCENT SODIUM CHLORIDE ENVIRONMENT M.S. Thesis**
Saleem Akhtar Sep. 1987 113 p
(AD-A188048) Avail: NTIS HC A06/MF A01 CSCL 11F

The electrochemical nature of corrosion provides a means of determining an almost instantaneous corrosion rate. Corrosion rate and the nature of corrosion attack were investigated for several high damping alloys based on the copper manganese, iron chromium aluminum, iron chromium molybdenum, and copper zinc systems in 3.5 percent NaC1 solution. The results of Potentiodynamic polarization and polarization resistance measurements were compared with the results of actual sea exposures. A zero resistance ammeter technique was used to measure the galvanic currents between galvanically coupled metals. The magnitude of the galvanic current provides an indication of the severity of galvanic corrosion which occurs in a 3.5 percent NaC1 environment. Scanning electron microscopy (SEM) was used to determine the nature of corrosion attack and the extent of film formation on the surface of each corroding alloy. GRA

**N88-18688#** Pennsylvania State Univ., University Park.
**HIGH TEMPERATURE OXIDATION STUDIES ON ALLOYS CONTAINING DISPERSED PHASE PARTICLES AND CLARIFICATION OF THE MECHANISM OF GROWTH OF SiO2 Annual Report, 15 Aug. 1986 - 14 Aug. 1987**
B. Munn, S. W. Park, and G. Simkovich Sep. 1987 34 p
(Grant AF-AFOSR-0298-85)
(AD-A188158; AFOSR-87-1688TR; AR-2) Avail: NTIS HC A03/MF A01 CSCL 11F

In the present investigation, the effects of dispersed SiO2 particles on the high temperature oxidation behavior of and alloys were studied. This study differs from previous investigations in that larger volume percents of SiO2 (5 to 40 vol percent) were incorporated into the alloys. Kinetic studies were done using an automatic recording semi-micro balance under the desired conditions (1 atm O2 and 1273, 1373, 1373K). Surface topographies of oxidized specimens were also prepared and examined optically and by scanning electron microscopy. Standard X-ray diffraction techniques were employed to identify the phases

present in the scale. Based upon extensive results obtained for the Ni-Cr-SiO2 alloy a model for oxide formation in this system is proposed. The results obtained for the Fe based system will also be presented in this report. GRA

**N88-18689#** Army Lab. Command, Watertown, Mass. Material Technology Lab.
**EFFECTS OF SULFUR CONTENT ON THE PLAIN STRAIN FRACTURE TOUGHNESS OF INERTIA WELDS IN 4340 STEEL Final Report**
William S. Ricci, Eric B. Kula, and James D. Colgate Sep. 1987 15 p
(AD-A188192; MTL-TR-87-53) Avail: NTIS HC A03/MF A01 CSCL 11F

The plain strain fracture toughness of post-weld, reheat treated inertia welds in two heats of AISI 4340 steel of equivalent tensile properties, but different sulfur concentrations, was determined. The adverse reorientation of elongated sulfide inclusions in both heats, resultant from the forging stage of the welding cycle, caused reductions in ductility and toughness that were not remedied by reheat treatments. The percent elongation of inertia welded joints was found to be no greater than 50 percent that of the parent metal even at the lowest sulfur concentrations of 0.004 percent. The fracture toughness of these welds in 0.014 percent S material, as determined from sharp notch fatigue cracked specimens, was actually found to be greater than that of welds in 0.004 percent S material. This was due to the more tortuous fracture path and the resultant greater fracture surface formed during crack propagation. L-C rather than L-R crack plane orientations for KIC specimens produced more reliable mechanical property data due to the more uniform microstructure ahead of the crack front. The magnitude of base metal elongation, especially in the short transverse orientation, is proposed as an index of inertia/friction weldability. GRA

**N88-18690#** Naval Research Lab., Washington, D.C.
**EFFECTS OF THERMAL AND THERMO-MECHANICAL TREATMENTS ON THE MECHANICAL PROPERTIES OF CENTRIFUGALLY CAST ALLOY 718 Final Report, Jul. 1984 - Mar. 1987**
D. J. Michel and H. H. Smith 15 Oct. 1987 22 p
(AD-A188195; NRL-MR-6101) Avail: NTIS HC A03/MF A01 CSCL 11F

The ability of thermal and thermo-mechanical treatments to impart improved microstructural and mechanical properties to nickel-base engine components has been investigated for centrifugally cast alloy 718. The effects of hot isostatic pressing (HIP) or thermal homogenizing treatments on the tensile, creep and fatigue properties of cast alloy 718 were evaluated at 427, 538, and 649 C. The results indicated that either HIP or thermal homogenizing processing of the as-cast alloy, followed by an aging treatment, produced improved fatigue crack propagation resistance when compared on the basis of stress intensity factor range. Creep life and ductility were reduced by both processing treatments but to a lesser degree by the homogenizing treatment. The mechanical behavior of the HIP processed and homogenized material is discussed on the basis of microstructural changes produced in the as-cast alloy by the processing treatments. GRA

**N88-18691#** Pacific Northwest Labs., Richland, Wash.
**THE EFFECTS OF LOW DOSES OF 14 MeV NEUTRONS ON THE TENSILE PROPERTIES OF THREE BINARY COPPER ALLOYS**
H. L. Heinisch 14 Sep. 1987 18 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987
(Contracts DE-AC06-76RL-01830; DE-AC06-76FF-02170)
(DE88-003400; PNL-SA-15265; CONF-871036-27) Avail: NTIS HC A03/MF A01

Miniature tensile specimens of high purity copper and copper alloyed respectively with five atom percent of Al, Mn, and Ni were irradiated with D-T fusion neutrons in the RTNS-II to fluences up to 1.3 x 10 to the 18th power n/square cm at 90 C. To compare fission and fusion neutron effects, some specimens were also irradiated at the same temperature to similar damage levels in the Omega West Reactor (OWR). Tensile tests were performed at room temperature, and the radiation-induced changes in tensile properties are compared as functions of displacements per atom (dpa). The irradiation- induced strengthening of Cu5 percent Mn is greater than that of Cu5 percent Al and Cu5 percent Ni, which behave about the same. However, all the alloys sustain less irradiation-induced strengthening by 14 MeV neutrons than pure copper. The effects of fission and fusion neutrons on the yield stress of the copper alloys correlate well on the basis of dpa, in contrast to the behavior of pure copper. DOE

**N88-18692#** Pacific Northwest Labs., Richland, Wash.
**INFLUENCE OF NEUTRON IRRADIATION ON THE CHARPY IMPACT PROPERTIES OF V-15Cr-5Ti**
N. S. Cannon, M. L. Hamilton, A. M. Ermi, D. S. Gelles, and W. L. Hu Aug. 1987 17 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987 Prepared in cooperation with Hanford Engineering Development Lab., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(DE88-003430; PNL-SA-15185; CONF-871036-30) Avail: NTIS HC A03/MF A01

Vanadium alloys are being evaluated for fusion reactor first wall and blanket applications to achieve both low neutron activation and operating temperatures above those suitable for ferritic steels. Both pre- and postirradiation impact tests have been completed on miniature Charpy specimens of the alloy V-15Cr-5Ti in the annealed condition (1200 C/1 hr/air cool). Irradiation was conducted in lithium filled TZM capsules at 365, 420, 520 and 600 C to doses ranging from 10 to 30 dpa. The ductile-to-brittle transition temperature was unexpectedly high in the unirradiated condition, on the order of 130 C. Impact tests demonstrate that irradiation induces a large upward shift in DBTT in this alloy. Fracture occurred primarily by transgranular cleavage in irradiated specimens at temperatures as high as 240 C. DOE

**N88-18693#** Lawrence Livermore National Lab., Calif.
**JOINING OF DISSIMILAR MATERIALS WITH THE PULSED Nd-YAG LASER**
A. C. Lingenfelter, C. N. Westrich, C. D. Anglin, and J. R. Murchie Nov. 1987 7 p Presented at the Laser Institute of America, San Diego, Calif., 8 Nov. 1987
(Contract W-7405-eng-48)
(DE88-003757; UCRL-97159; CONF-8711121-1) Avail: NTIS HC A02/MF A01

The pulsed Nd-YAG laser welding process is an excellent method for joining dissimilar metals. The ability to focus the beam to a small spot size and the capability with a precision positioner to locate the beam very precisely, permits close control of the fusion zone composition. The nature of the pulsed laser process requires that the fusion zone composition exhibit good cracking resistance. Frequently a filler metal can be introduced which will tolerate the dilution from both of the base metals and produce a crack-free weld. Examples are cited to illustrate a number of dissimilar metal combinations. DOE

**N88-18694#** Sandia National Labs., Albuquerque, N. Mex.
**THERMAL FATIGUE OF STAINLESS STEEL**
W. B. Jones, R. J. Bourcier, and J. A. VanDen Avyle Dec. 1987 39 p
(Contract DE-AC04-76DP-00789)
(DE88-004146; SAND-87-0696) Avail: NTIS HC A03/MF A01

Two austenitic steels, 316 Stainless Steel and Alloy 800, have been examined under conditions of both isothermal low cycle fatigue (LCF) and thermomechanical fatigue (TMF). The TMF tests were conducted between 649 and 360 C with a carefully controlled triangular waveform. The LCF tests were performed at 649 C and both kinds of tests were subjected to a strain range of 0.5 percent. The shortened life to 40 percent for Stainless Steel and to 5 percent for Alloy 800. The microstructural evolution occurring in both alloys has been examined and we conclude these do not

play a role in the life shortening caused by TMF. The TMF does produce asymmetric hysteresis loops with large tensile peak stresses in tests where the maximum temperature corresponded with the peak compressive stress. The influence of TMF on fatigue crack growth rates has been measured and it was found that TMF accelerated crack growth in Alloy 800 and slowed it down slightly in 316 Stainless Steel. The dominant influence of TMF appears to be in fatigue crack initiation, with the tensile peak stress development driving early crack initiation. DOE

**N88-18695#** Sandia National Labs., Albuquerque, N. Mex.
**CORROSION RESISTANCE OF ELECTRODEPOSITED AMORPHOUS Ni-Cr-P ALLOYS**
T. R. Guilinger 1987 17 p Presented at the Symposium on Metallic Glasses, Honolulu, Hawaii, 19 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE88-005116; SAND-87-1077C; CONF-8710257-1) Avail: NTIS HC A03/MF A01

The outstanding corrosion resistance of amorphous Ni-Cr-P alloys (with greater than 10 at. percent Cr and greater than 20 at. percent P) prepared by rapid liquid quenching encourages the development of an electroplating bath for the deposition of these alloys. We used a chloride-based bath of Cr(III) and Ni, with hypophosphite or phosphorous acid as the phosphorus source and citrate ion as a complexing agent, to produce such a bath. Anodic polarization and current decay at constant potential were performed on amorphous electrodeposits with varying Cr content in pitting (HCl) and non-pitting (H sub 2 SO sub 4) electrolytes. The electrodeposits demonstrated outstanding corrosion resistance in both electrolytes, especially when their Cr content exceeded ca. 10 at. percent, when compared to crystalline Ni, amorphous NiP, 304 SS, and Hastelloy C-276. DOE

**N88-18696#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
**INFLUENCE OF GRAIN BOUNDARY PHOSPHORUS SEGREGATION ON HYDROGEN EMBRITTLEMENT IN STEEL**
P. A. Platonov, A. D. Amaev, V. A. Nikolaev, I. E. Tursunov, E. A. Krasikov, V. I. Levit, S. V. Nikitin, A. Yu. Biryukov, K. V. Gorskij, and V. V. Popov 1986 28 p In RUSSIAN
(DE88-700176; IAE-4319/11) Avail: NTIS (US Sales Only) HC A03/MF A01

Experimental investigation into the effect of grain-boundary impurity segregations on hydrogen embrittlement of pearlite steel was carried on. It is shown that thermal ageing and subsequent hydridation result in complete loss of ductility. At that phosphorus and carbon impurity aggregations form casing synergism between thermal and hydrogen embrittlements. The similar interaction causing the formation of intergranular cracks with out applying external stress can result in fracture of idle steel. The determining effect on the fracture mechanism of hydrogen interaction iwht intergrandular microstructural heterogeneities (in particular, impurity segregations) is noted. DOE

**N88-18697#** Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil).
**DYNAMICAL PROPERTIES OF ALUMINIUM FROM EXPERIMENTAL DISPERSION RELATIONS**
J. B. V. SallesFilho, R. Fulfaro, and L. A. Vinhas May 1987 25 p
(DE88-700240; IPEN-Pub-105) Avail: NTIS (US Sales Only) HC A03/MF A01

Measurements of phonon dispersion relations of aluminum along the high symmetry directions were performed by coherent inelastic scattering of thermal neutron technique. All measurements were taken at room temperature using the IPEN triple axis neutron spectrometer. The results obtained with accuracy are in good agreement with the published data. The dispersion relations were calculated theoretically within the framework of Born-von Karman and Axially Symmetric models, including interactions up to the fifth nearest shell of atoms. The elastic constants were determined using the values of sound propagating velocity obtained directly from the dispersion relations along high symmetry directions of the crystal. Applying to theoretical models the force constants of aluminum were also determined. From these data several physical properties of the metal can be obtained. DOE

**N88-18698#** Technical Research Centre of Finland, Espoo.
**PROTECTING OLD OIL TANKS MADE OF STEEL AGAINST INTERNAL CORROSION USING ORGANIC COATINGS**
T. Kaunisto Jun. 1987 41 p In FINNISH
(DE88-751089; VTT-TIED-707) Avail: NTIS (US Sales Only) HC A03/MF A01

Water containing chlorides and sulphates can cause corrosion on the internal surfaces of buried steel tanks. After 1974 at least the bottom area of all new tanks has been painted to prevent corrosion. Older tanks are normally without any internal corrosion protection. Laboratory and field tests were carried out to investigate the applicability of glass fiber reinforced plastics and four different types of epoxy coating to the corrosion protection of the bottom area of old steel tanks. Glass fiber reinforced plastics, solventless epoxy paint and epoxy paint with normal or low content of solvent investigated showed good adhesion to steel and chemical resistance. The adherence of the resin-modified epoxy paint tested was very sensitive to the cleaning of the steel surface and its chemical resistance in petrol tanks was poor. Consequently, it is not recommended for coating petrol tanks. DOE

**N88-18699#** Stuttgart Univ. (West Germany). Fakultaet fuer Physik.
**STRUCTURAL ANALYSIS USING X-RAY SCATTERING AND NEUTRON SCATTERING ON BINARY AMORPHOUS (Co,Cu)Ti ALLOYS Ph.D. Thesis [STRUKTURUNTERSUCHUNG MITTELS ROENTGEN- UND NEUTRONENBEUGUNG AN BINAEREN AMORPHEN (CO, CU)-TI-LEGIERUNGEN]**
Alfred Mueller 1986 128 p In GERMAN
(ETN-88-91487) Avail: NTIS HC A07/MF A01

The partial structural factors of amorphous Cu50Ti50 and Co25Ti75 were studied in neutron and X-ray scattering experiments. Amorphous bands were produced from binary (Cu, Co)-Ti alloys using the melt-spin method. The method of isotopic substitution was used in the experiments. The neutron scattering experiment on Co25Ti75 failed. Three different scattering experiments on Cu50Ti50 allowed the determination of the partial structural factors and pair correlation functions. Two scattering experiments on Co25Ti75 allowed the determination of the total structural factors and pair correlation functions. A comparison between both amorphous phases shows an equally strong binding tendency. Both atom species in Co25Ti75 show an atomic character, while in Cu50Ti50 titanium seems to be bound in a covalent way. ESA

**N88-18700** New South Wales Univ., Sydney (Australia).
**STUDIES OF THE ELECTRON SPECTRUM WITH REFERENCE TO THE CLEAN SURFACES OF IRON, COBALT AND NICKEL AND THEIR SUBSEQUENT EXPOSURE TO OXYGEN Abstract Only. Ph.D. Thesis**
M. G. Ramsey Sep. 1986 304 p
Avail: Issuing Activity

The electron spectrum of the clean and oxygen exposed (110) surfaces of the transition metals Fe, Co and Ni were studied. This included consideration of the core-valence-valence (CVV) Auger emission, autoionization electron emission, resonant photoemission, the hole-hole Coulomb interaction energy U sub eff, the electron loss spectra, the core loss spectra and the reflected extended electron energy loss fine structure (REELFS). Arguing from Auger, autoionization and published resonant photoemission results it is suggested that U sub eff does not alter appreciably on oxidation. The use of XPS binding energies in Auger experiments is critically evaluated. The REELFS structure discovered beyond the shallow M(2,3) core loss edge is treated analagously to EXAFS and shown to have potential as an economical surface technique. Author

**N88-18701** New South Wales Univ., Sydney (Australia). School of Chemistry.
**AN INVESTIGATION OF METAL COMPLEXES OF SOME 2-SUBSTITUTED AND 2,6-DISUBSTITUTED PYRIDINE N-OXIDES Abstract Only. Ph.D. Thesis**
F. M. Zafar Kaifi 1986 145 p
Avail: Issuing Activity

Metal complexes of some 2-substituted and 2,6-disubstituted pyridine N-oxides have been prepared and characterized by infrared, electronic and X-ray powder diffraction spectra, by magnetic measurements to liquid nitrogen temperature and by X-ray crystal structure determinations. The ligand 2-pyridine carboxaldehyde 1-oxide phenylhydrazone (pohp) behaves as a unidentate O-donor. Crystal structure determinations show that (Ni(pohp)4Br)Br is five-coordinate and that ((pohp)2H(+))(Cu(I)Br(2-)) is produced by reaction of pohp with CuII bromide, involving reduction of CuII to CuI by the hydrazino-ligand. X-ray crystal structure determinations were obtained for complexes of 2-pyridine carboxaldehyde 1-oxide 2'-quinolylhydrazone (poqh) and 2-pyridine carboxaldehyde 1-oxide 2'-pyridylhydrazone (poph) showing ONN coordination by these ligands. The ligand 2,6-pyridine carboxaldehyde 1-oxide bis(2'-phridhylhydrazone) (dpoph) yielded a series of 1:1 complexes with NiII and CuII salts. In addition, 2:1 complexes of type (Cu Hal2)2dpoph were obtained with CuII halides; these complexes are antiferromagnetic and appear to contain binucleating ligand with N-oxide bridging between the CuII ions. Author

**N88-18702#** National Bureau of Standards, Gaithersburg, Md.
**INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING, METALLURGY: TECHNICAL ACTIVITIES 1987 Annual Report**
Oct. 1987 106 p
(PB88-157722; NBSIR-87/3615) Avail: NTIS HC A06/MF A01 CSCL 11F

The FY87 activities of the Metallurgy Div. of the NBS are summarized. The research centers upon the structure processing properties relations of metals and includes alloys and on the methods of their measurement. The activities also include the generation and evaluation of critical materials data. Efforts comprise studies of metallurgical processing, corrosion and wear, chemical metallurgy, electrodeposition, nondestructive characterization and magnetic materials. Also described are three cooperative programs with American professional societies and industry: the American Society for Metals - NBS Alloy Phase Diagram Program, the National Association of Corrosion Engineers - NBS Corrosion Data Program, the American Iron and Steel Institute - NBS Steel Sensor Program, and the Aluminum Association. Work in support of other government agencies includes a major program to assist the Nuclear Regulatory Commission in addressing the critical national program of disposing of high level nuclear waste in geologic repositories. Author

**N88-18703#** Oak Ridge National Lab., Tenn.
**PHOTOACOUSTIC STUDIES OF SURFACE PLASMONS IN METALLIC MICROSTRUCTURES**
T. Inagaki, J. P. Goudonnet, and E. T. Arakawa 1987 8 p Presented at the Conference on Photoacoustic and Photothermal Phenomena, Heidelberg, Fed. Republic of Germany, 27 Jul. 1987 Prepared in cooperation with Osaka Kyoiku Univ., Japan and Dijon Univ., France
(Contract DE-AC05-84OR-21400)
(DE88-004423; CONF-8707146-1) Avail: NTIS HC A02

Use of the photothermal method made it possible to explore new aspects of surface plasmon behavior in various types of metallic microstructures. DOE

**N88-18704#** Sandia National Labs., Albuquerque, N. Mex.
**CLEANLINESS TESTS WITH THE OMEGA METER: A COMPARATIVE STUDY FOR SOLDER FLUX REMOVAL**
E. P. Lopez Dec. 1987 18 p
(Contract DE-AC04-76DP-00789)
(DE88-004634; SAND-87-1882) Avail: NTIS HC A03/MF A01

This paper reports on a dynamic conductivity test which indicates the effectiveness of solder flux removal. The Omega Meter, a device to measure residual ionic contaminants has been used to measure cleanliness as required by MIL-P-15110 and MIL-P-28809. The cleaning efficiency of seven solvents in removing three basic types of rosin solder fluxes after solder dipping has been evaluated. Results obtained indicate fairly good correlation with those obtained from radiochemical techniques and evaporative rate analysis using the Meseran Surface Analyzer. In this study, using vapor degreasing as the method of cleaning, isopropyl alcohol, trichloroethylene, and 1,1,1 trichloroethane (stabilized), respectively, were the best single solvents identified in the removal of types R, RMA, and RA rosin solder fluxes. DOE

**N88-18705#** Lawrence Livermore National Lab., Calif.
**METALLURGICAL ANALYSIS OF FRACTURED F-27 AIRCRAFT LANDING GEAR**
C. E. Witherell 15 Dec. 1987 28 p
(Contract W-7405-eng-48)
(DE88-005885; UCID-21296) Avail: NTIS HC A03/MF A01

The Materials Division of Lawrence Livermore National Laboratory (LLNL's) Chemistry and Materials Science Department was asked to conduct a study of a fractured component of the main (starboard) landing gear on the F-27 aircraft (N768RL). The purpose of the study was to determine from metallurgical evidence the probable failure mode, its cause, and contribution to the recent landing incident at Livermore. DOE

**N88-18706#** GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Werkstofforschung.
**COMPUTER AIDED TESTING PROCEDURE FOR STRESS CORROSION CRACKING INVESTIGATIONS [RECHNERGESTUETZTES PRUEFVERFAHREN FUER SPANNUNGSRISSKORROSIONSUNTERSUCHUNGEN]**
W. Dietzel, K.-H. Balzereit, and K. H. Schwalbe 1986 12 p In GERMAN Presented at a conference, Bad Nauheim, Fed. Republic of Germany, 27-28 Nov. 1986
(GKSS-86/E/63; ISSN-0344-9629; ETN-88-91454) Avail: NTIS HC A03/MF A01

A tensile-test machine was developed in order to transfer the principle of slow-strain-rate tests to fracture mechanics tests. Compact-tensile specimens with a fatigue crack were monotonically tensile-loaded at different, constant drawing rates, in different media. In contrast with the usual fracture mechanics tests, the drawing rates were substantially lower (as low as 0.1 microm/hr). The test equipment, control system, and data acquisition and evaluation are described. The parameters determining the stress corrosion cracking of the system Al2024 T351 in a 3.5 percent NaCl solution were characterized. The method also provides the effective crack resistance curve at the occurrence of stress corrosion cracking. A disadvantage of the procedure is that it requires a relatively large experimental effort. ESA

**N88-18707*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CREEP BEHAVIOR OF TUNGSTEN/NIOBIUM AND TUNGSTEN/NIOBIUM-1 PERCENT ZIRCONIUM COMPOSITES Final Report**
Donald W. Petrasek and Robert H. Titran 1988 25 p Presented at the 5th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 11-14 Jan. 1988; sponsored by New Mexico Univ.
(Contract DE-AI03-86SF-16310)
(NASA-TM-100804; DOE/NASA/16310-5; E-3984; NAS 1.15:100804) Avail: NTIS HC A03/MF A01 CSCL 11F

The creep behavior and microstructural stability of tungsten fiber reinforced niobium and niobium 1 percent zirconium was determined at 1400 and 1500 K in order to assess the potential of this material for use in advanced space power systems. The creep behavior of the composite materials could be described by a power law creep equation. A linear relationship was found to exist between the minimum creep rate of the composite and the inverse of the composite creep rupture life. The composite materials

had an order of magnitude increase in stress to achieve 1 percent creep strain and in rupture strength at test temperatures of 1400 and 1500 K compared to unreinforced material. The composite materials were also stronger than the unreinforced materials by an order of magnitude when density was taken into consideration. Results obtained on the creep behavior and microstructural stability of the composites show significant potential improvement in high temperature properties and mass reduction for space power system components. Author

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

**N88-18708*#** Alabama Univ., Huntsville. School of Science.
**STUDY OF THE PRODUCTION OF SOME SUPERCONDUCTING AND MAGNETIC MATERIALS BY SOLIDIFICATION IN THE DROP TUBE AND DROP TOWER Semiannual Report, Jun. 1985 - May 1987**
M. K. Wu Jan. 1987 30 p
(Grant NAG8-032)
(NASA-CR-182494; NAS 1.26:182494) Avail: NTIS HC A03/MF A01 CSCL 11C

A systematic study on the relationship between the microstructure and physical properties of several superconducting materials prepared by solidification in low gravity was conducted. Further study of the materials, such as the applications of hydrostatic pressure which is known to be an effective mean to vary the electronic structure of materials, in conjunction with the detailed microstructure analysis of the samples was also performed to better understand the low gravity effects on the enhancement of the electronic properties. Results of the studies on the directionally solidified AlInSn alloys processed in the KC-135 aircraft and immiscible GaBi alloy prepared during free fall in the Marshall Space Flight Center Drop Tower are presented. Author

**N88-18709#** Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
**FUNDAMENTAL STUDIES OF CORROSION OF NONOXIDE STRUCTURAL CERAMICS Annual Report No. 1, 1 Jan. - 31 Dec. 1986**
R. E. Tressler and K. E. Spear Jan. 1987 165 p Sponsored by Gas Research Inst., Chicago, Ill.
(Contract GRI-5084-260-1083)
(PB88-141536; GRI-87/0088) Avail: NTIS HC A08/MF A01 CSCL 11B

The thermodynamics and kinetics of the corrosion process in monolithic structural ceramics materials are investigated. In the second year of the project, a thermodynamic analysis of the Si-C-O system was performed to establish the equilibrium at the gas-oxide interface and the SiC-oxide interface. Based on the results, a kinetic model of the oxidation process was constructed using parallel transport of oxidants through the oxide via interstitial and vacancy mechanisms. For analysis of the films, instruments sensitive to structure and elemental composition provided structural and chemical information about the reaction products and enabled the identification of intermediate reaction layers, isotopes were used to determine the relative rates of diffusion of oxidant and reaction products and thus establish the rate limiting diffusing species. GRA

**N88-18710#** Ceramphysics, Inc., Westerville, Ohio.
**RESEARCH ON HIGH-SPECIFIC-HEAT DIELECTRICS Final Technical Report, 1 Apr. 1986 - 30 Apr. 1987**
W. N. Lawless, C. F. Clark, B. R. Patton, P. K. Kahol, and N. S. Dalal 11 May 1987 190 p Prepared in cooperation with Ohio State Univ., Columbus, West Virginia Univ., Morgantown and Pennsylvania State Univ., University Park
(Contract F49620-86-C-0049)
(AD-A187248; AFOSR-87-1452TR) Avail: NTIS HC A09/MF A01 CSCL 11B

This Annual Report details a program of research on composite spinel ceramic materials with enormous specific heat maxima in the temperature range 5 to 20 K. The results obtained so far have suggested an attractive picture for the ordering phenomena in the B-site spinels, $CdCr_2O_4$ and $ZnCr_2O_4$. Significant progress in characterizing and controlling the fabrication of the spinel materials has been made. Pure powders, compacted disks, as well as the 9/1 columbite composite have been made and characterized. Magnetocaloric experiments reveal no trace of hysteresis, which means that the phenomena involved in the low temperature transitions in the Zn and Cd spinels must involve second order transitions. Adiabatic demagnetization cooling above TN and also at low temperatures is indicative of paramagnetic spins, while a region of demagnetization heating just below TN seems to indicate anti-ferromagnetic ordering. Measurements have also discovered an amazing anomaly in the dielectric constant at the anti ferromagnetic transition. GRA

**N88-18711#** Army Lab. Command, Watertown, Mass. Material Technology Lab.
**SHELF LIFE DEGRADATION OF SELECTED ANAEROBIC THREADLOCKING ADHESIVES AT VARIOUS STORAGE TEMPERATURES Final Report**
Paul R. Bergquist and Stanley E. Wentworth Sep. 1987 18 p
(AD-A187712; MTL-TR-87-51) Avail: NTIS HC A03/MF A01 CSCL 11A

This study addresses the shelf life degradation of three commercially available anaerobic adhesives maintained at 0 C, 22 C, and 50 C. A titrimetric procedure was developed to monitor the change in the adhesive peroxide initiator concentration over an 18 month period. The change was then related to a corresponding decrease in the breakaway and prevailing torque strengths of bonded nuts and bolts prepared with aged adhesives. It was determined that elevated temperature storage caused degradation of the adhesives and that the titrimetric method could be useful as a quality control method were such storage may be unavoidable. GRA

**N88-18712#** Syntheco, Inc., Gastonia, N.C.
**LITHIUM FAST-ION CONDUCTORS: POLYMER BASED MATERIALS Final Report, Jun. 1983 - May 1987**
John R. Wasson 30 May 1987 24 p
(Contract N00014-83-C-0440)
(AD-A187879) Avail: NTIS HC A03/MF A01 CSCL 07D

The syntheses and room temperature conductivities of a wide variety of simple and polymeric lithium salts have been explored without finding materials with significant ambient temperature ionic conductivities. Some of the materials may be of interest in other contexts. A study of lithium tetrafluoroborate in polyacrylonitrile showed that the composites could form the basis for a sensitive humidity sensor. Preliminary studies of a number of lithium salt-polymer systems showed that water was responsible for the observed conductivities. GRA

**N88-18713#** International Business Machines Corp., San Jose, Calif.
**SOLUBLE POLYSILANE DERIVATIVES: CHEMISTRY AND SPECTROSCOPY**
R. D. Miller, J. F. Rabolt, R. Sooriyakumaran, W. Fleming, and G. N. Fickes 13 Nov. 1987 39 p
(Contract N00014-85-C-0056)
(AD-A187889; TR-14) Avail: NTIS HC A03/MF A01 CSCL 07F

Polysilanes represent an interesting class of radiation sensitive polymers for which new applications have been discovered. Even though the polymer backbone is composed only of silicon silicon single bonds, all high molecular weight polysilanes absorb strongly in the UV. The position of this absorption depends not only on the nature of the substituents, but also on the conformation of the backbone. In this regard, materials where the polymer backbone is locked into a planar zigzag conformation absorb at much longer

wavelengths than comparable materials where the backbone is either disordered or nonplaner (e.g., helical). A planar zigzag backbone is often observed for symmetrically substituted derivatives in the solid state when there are also significant intermolecular interactions such as side chain crystallization. These materials are strongly thermochromic. GRA

**N88-18714#** International Business Machines Corp., San Jose, Calif.
**PHOTOPHYCIS AND PHOTOCHEMISTRY OF POLY(DI-N-HEXYLSILANE) IN ROOM TEMPERATURE SOLUTION**
J. Michl, J. Downing, T. Karatsu, K. A. Klingensmith, and G. H. Wallrath 13 Nov. 1987 21 p
(Contract N00014-85-C-0056)
(AD-A187890; TR-15) Avail: NTIS HC A02/MF A01 CSCL 07C

Polysilane high polymers represent a new class of radiation sensitive polymers which are receiving considerable attention because of their curious spectroscopic properties and the development of a number of new applications. The lowest singlet excitation is sigma type, is localized in all-trans segments, and travels rapidly along the polymer backbone from shorter to longer segments. This energy transfer is competitive with fluorescence and polymer chain scission. The lengths of the low energy emitting segments of poly(di-n-hexylsilane) in solution have been estimated at 10 to 20 Si units. The reactions subsequent to chain scission are complex and poorly understood, but it is certain that complex silicon based radicals are formed. GRA

**N88-18715#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
**SYNTHESIS AND STRUCTURE PROPERTY STUDIES OF TOUGHENED EPOXY RESINS VIA FUNCTIONALIZED POLYSILOXANES Final Report, 1978 - 1986**
J. S. Riffle, E. M. Yorkgitis, C. Tran, I. Yilgor, and J. L. Hedrick 30 Sep. 1987 4 p
(Contract N00014-78-C-0629)
(AD-A187984) Avail: NTIS HC A02/MF A01 CSCL 11I

Epoxy resins chemically modified with functionally terminated poly(dimethyl siloxane), poly(dimethyl-co-methyltrifluoropropyl siloxane) and poly(dimethyl-co-diphenyl siloxane) oligomers are described in terms of their synthesis, morphology, solid-state properties, and friction and wear properties. The compatibility between the epoxy resin and the siloxane modifiers can be enhanced by increasing the percentage of methyltrifluoropropyl (TFP) siloxane or diphenyl (DP) siloxane relative to dimethyl siloxane. The compatibility of the siloxane modifier with epoxy resin subsequently controls the size and make-up of the phase-separated elastomeric domains. Fracture toughness of the epoxy resin can be improved by modification with siloxanes containing 40 percent or higher TFP content or 20 and 40 percent DP content. Both fracture toughness and modulus changes are given a morphological basis. Friction and wear properties in both fatigue and abrasive wear tests have been found to be related to changes in modulus, fracture toughness, and morphology in ways dependent on the particular modifier. GRA

**N88-18716#** Fluorochem, Inc., Azusa, Calif.
**POLYMERIZATION OF FLUORINATED DIACETYLENES**
Kurt Baum, Paul G. Cheng, Ronald J. Hunadi, and Clifford D. Bedford 10 Nov. 1987 13 p
(Contract N00014-84-C-0388)
(AD-A188051; TR-4) Avail: NTIS HC A03/MF A01 CSCL 07F

Perfluoroalkylene diacetylenes, underwent thermal polymerization at 250 to 350 C to give glassy polymers stable to 450 C. Partial polymerization of the volatile monomers gave oligomers that are processable at atmospheric pressure. Polymers with similar thermal stability were obtained by transition metal catalyzed polymerization of the monomers at moderate temperatures. GRA

**N88-18717#** Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
**HIGH YIELD SYNTHESIS OF B4C/BN CERAMIC MATERIALS BY PYROLYSIS OF POLYMERIC LEWIS BASE ADDUCTS OF DECABORANE(14)**
William S. Rees, Jr. and Dietmar Seyferth 4 Nov. 1987 20 p Submitted for publication
(Contract N00014-85-K-0645)
(AD-A188154; TR-24) Avail: NTIS HC A03/MF A01 CSCL 07F

In previous work, we have developed useful polymeric precursors whose pyrolysis provides high yields of silicon nitride or silicon nitride/silicon carbide blends. Boron containing ceramics (the carbide, nitride, phosphides, silicides and others) are a class of ceramic materials whose properties are very attractive in terms of high technology applications. Thus boron carbide has exceptional thermal stability (mp 2450 C), a microhardness of 4.05 GPa (vs 2.53 GPa for SiC), high compressive strength and radiation stability. Various routes exist for the preparation of boron carbide and boron nitride. For boron carbide, however, none of these proceed by way of a processable intermediate. For boron nitride, preparative routes based on the pyrolysis of silicon substituted, oligomeric borazines and of a boric acid/1,2,3-propanetriol condensation product have been reported. We report the results of our initial efforts to develop processible polymeric precursors whose pyrolysis gives boron-containing ceramic materials in high yields. GRA

**N88-18718#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
**SYNTHESIS AND STRUCTURE PROPERTY STUDIES OF TOUGHENED EPOXY RESINS VIA FUNCTIONALIZED POLYSILOXANES. FRICTION AND WEAR STUDIES Final Report, 1 May - 30 Sep. 1986**
Norman S. Eiss, Jr. 30 Mar. 1987 8 p
(Contract N00014-78-C-0629)
(AD-A188258) Avail: NTIS HC A02/MF A01 CSCL 11I

The friction and wear properties of copolymers of dimenthyl (DM) and methyl trifluoropropyl (TFP) siloxane and of ATBN and CTBN rubber modified epoxies were previously reported. In the continuation of this work the friction and wear of the copolymers of dimethyl and diphenyl (DP) siloxane modified epoxies were measured. In addition, an abrasive wear experiment was performed to determine if the wear rates varied as the inverse of the energy to rupture of the materials. Another experiment was performed in which the wear debris produced was blown out of the wear track to test the hypothesis that the wear debris changed the predominant wear mechanism from fatigue to abrasive and thus caused a higher wear rate. The experiments and the results are described in this report. GRA

**N88-18719#** Oak Ridge National Lab., Tenn.
**NATIONAL CENTER FOR SMALL-ANGLE SCATTERING RESEARCH: REPORTS ON MEASUREMENTS CARRIED OUT BY USERS OF THE FACILITIES OF THE NCSASR, DECEMBER 1, 1985-SEPTEMBER 30, 1987**
S. Spooner and L. B. Maddox 1987 254 p
(Contract DE-AC05-84OR-21400)
(DE88-003754; ORNL/TM-10614) Avail: NTIS HC A12/MF A01

Reports are presented on small angle scattering of alloys, emulsion, micellar systems, polymers, and biological materials. DOE

**N88-18720#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**THE INTERGRANULAR SEGREGATION OF BORON IN SUBSTOICHIOMETRIC NI3AI**
A. Choudhury Dec. 1987 317 p
(Contract DE-AC05-84OR-21400)
(DE88-004783; ORNL/TM-10508) Avail: NTIS HC A14/MF A01

The intermetallic compound Ni sub 3 Al offers promise as a material for high temperature applications. In addition to its unusual

property of increasing strength with temperature (until approx. 700 C), it has excellent corrosion and oxidation resistance. Microalloying the alloy with boron has been shown to be dramatically effective in improving its inherent intergranular brittleness. This improvement results from the strong tendency of boron to segregate to the grain boundaries of Ni sub 3 Al. This research deals with the study of the segregation behavior of boron. Auger electron spectroscopy was chosen as the technique adopted to study this segregation. The strong effect of segregant level on the grain boundary strength level can be controlled by thermal history variations and by variations in the level of solute in the bulk. Cathodic hydrogen charging was shown to be a potent tool in opening up other wise cohesive boundaries for analysis. The effective binding energy of boron at the grain boundaries of Ni sub 3 Al was calculated from experimental data; it was found to vary between 0.2 and 0.45 eV. Kinetics of segregation have been investigated; the present set of kinetic studies were shown to be inadequate to find a diffusion coefficient and that temperatures lower than those studied here need to be used. DOE

**N88-18721#** Rockwell International Corp., Golden, Colo.
**ADHESION OF PVD TITANIUM COATINGS TO BERYLLIUM SUBSTRATES**
A. F. Jankowski 1987 31 p Presented at the International Conference on Metallurgical Coatings, San Diego, Calif., 23 Mar. 1987
(Contract DE-AC04-76DP-03533)
(DE88-005147; RFP-4044; CONF-870388-17) Avail: NTIS HC A03/MF A01

Influencing the adhesive mechanism is the surface condition of the substrate. Along with deposition variables, as substrate temperature, vacuum pressure and coating rate, a mechanical interlocking model of adhesion is proposed. An approximation of the adhesive failure stress is presented based on classical fracture mechanic principles. Incorporated into the model is an X-ray diffraction texture characterization of the coating microstructure that is shown to vary with the deposition parameters. Experimental stresses to induce bond failure, in an adherence pull test, are compared with those values predicted by the model (which considers a state of plane strain at the coating-substrate interface). DOE

**N88-18722#** Sandia National Labs., Albuquerque, N. Mex.
**ANODIC BEHAVIOR OF NI-P AND NI-Cr-P METALLIC GLASSES**
R. B. Diegle, N. R. Sorensen, C. R. Clayton, and M. A. Helfand 1987 24 p Presented at the 172nd Meeting of the Electrochemical Society, Honolulu, Hawaii, 18 Oct. 1987 Prepared in cooperation with State Univ. of New York, Stony Brook
(Contract DE-AC04-76DP-00789)
(DE88-005334; SAND-87-3088C; CONF-871027-16) Avail: NTIS HC A03/MF A01

The passivation behavior of glassy Ni-XCr-20P (X = 0,3,6, and 10 at. percent) alloys is treated from an electrochemical standpoint, with supporting data for passive film chemistries obtained by X-ray photoelectron spectroscopy. Evidence is presented for passivation of Ni-20P by adsorption of hypophosphite anion, rather than a nickel oxide or oxyhydroxide film characteristic of pure Ni. This chemical passivity exists over a narrow potential range of about 500 mV. In contrast, the Cr-containing alloys develop more conventional three-dimensional films, which are enriched in phosphorus anions in the inner region and in Cr (+3) species in the outer region. Alloying with Cr extends the passive potential range, reduces the passive current density, and confers excellent pitting resistance to the alloys. DOE

**N88-18723#** Technical Research Centre of Finland, Espoo.
**CHARACTERISTICS AND USE OF LUBRICATING GREASES**
M. Kytoe Feb. 1987 41 p In FINNISH
(DE88-751103; VTT-TIED-679) Avail: NTIS (US Sales Only) HC A03/MF A01

The aim of this literature review of lubricating greases is to inform the consumer of the constitution and characteristics of different greases, to make selection of a suitable grease for demanding uses and comprehension of product specifications easier. A significant consitituent of lubricating greases is the thickener, which binds the lubricant and gives the grease a semi-solid state. The greases contain 3 to 30 percent of thickener, 70 to 95 percent of base oil and 0 to 10 percent of additives. Several greases of different type are used, dominant today being lithium greases. This dominance is based on a relatively low price and at least satisfactory properties in most of the conventional uses. The thickener of the lithium greases is lithium soap and the base oil usually mineral oil. Synthetic greases are used only for special uses. The consistency is the basic characteristic of greases. Other quantities that characterize greases are, for example, drop point, water resistance and corrosion protection characteristics. DOE

**N88-18724#** Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
**INVESTIGATIONS OF THE STABILITY OF THE CELL OPENING OF SOFT POLYURETHANE FOAMS Ph.D. Thesis [UNTERSUCHUNGEN ZUR STABILITAET DER ZELLOEFFNUNG VON POLYURETHAN-WEICHSCHAEUMEN]**
Sabine Thiel 1987 97 p In GERMAN
(ETN-88-91481) Avail: NTIS HC A05/MF A01

The reasons for the stability of open-cell polyurethane foams and the parameters which influence their stability were investigated. The existing theories on cell opening and foam stability are reviewed. Two models were developed for the mathematical verification of the stability. The polyeder bubble model uses the finite difference method; results show satisfactory agreement with photographs. The second model describes the bubble growth in the foam and allows the determination of the geometry of the foam structure. It is found that an essential condition for foam stability is a sufficient strength of the viscous foam material. The strengthening of the liquid material depends only on the evolution of the chemical reactions. Thus, cell opening and foam stability are mainly a question of properly selected foaming recipe. ESA

**N88-18725*** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**POLYETHER-POLYESTER GRAFT COPOLYMER Patent**
Vernon L. Bell, inventor (to NASA) 8 Dec. 1987 8 p Filed 24 Apr. 1986 Supersedes N86-26435 (24 - 17, p 2710)
(NASA-Case-LAR-13447-1; NAS 1.71:LAR-13447-1; US-Patent-4,711,932; US-Patent-Appl-SN-855879; US-Patent-Class-525-397; US-Patent-Class-525-905) Avail: US Patent and Trademark Office CSCL 11B

Described is a polyether graft polymer having improved solvent resistance and crystalline thermally reversible crosslinks. The copolymer is prepared by a novel process of anionic copolymerization. These polymers exhibit good solvent resistance and are well suited for aircraft parts. Previous aromatic polyethers, also known as polyphenylene oxides, have certain deficiencies which detract from their usefulness. These commercial polymers are often soluble in common solvents including the halocarbon and aromatic hydrocarbon types of paint thinners and removers. This limitation prevents the use of these polyethers in structural articles requiring frequent painting. In addition, the most popular commercially available polyether is a very high melting plastic. This makes it considerably more difficult to fabricate finished parts from this material. These problems are solved by providing an aromatic polyether graft copolymer with improved solvent resistance and crystalline thermally reversible crosslinks. The graft copolymer is formed by converting the carboxyl groups of a carboxylated polyphenylene oxide polymer to ionic carbonyl groups in a suitable solvent, reacting pivalolactone with the dissolved polymer, and adding acid to the solution to produce the graft copolymer.

Official Gazette of the U.S. Patent and Trademark Office

**N88-18726*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**TRIBOLOGICAL PROPERTIES OF ALUMINA-BORIA-SILICATE FABRIC FROM 25 TO 850 C Final Report**
Christopher DellaCorte Mar. 1988 15 p
(Contract DE-AI01-86CE-50162)
(NASA-TM-100806; E-3986; DOE/NASA/50162-2; NAS 1.15:100806) Avail: NTIS HC A03/MF A01 CSCL 11B

Demanding tribological properties are required of the materials used for the sliding seal between the sidewalls and the lower wall of the variable area hypersonic engine. Temperatures range from room temperature and below to operating temperatures of 1000 C in an environment of air, hydrogen, and water vapor. Candidate sealing materials for this application are an alumina-boria-silicate, ceramic, fabric rope sliding against the engine walls which may be made from copper- or nickel-based alloys. Using a pin-on-disk tribometer, the friction and wear properties of some of these potential materials and possible lubrication methods are evaluated. The ceramic fabric rope displayed unacceptably high friction coefficients (0.6 to 1.3) and, thus, requires lubrication. Sputtered thin films of gold, silver, and CaF2 reduced the friction by a factor of two. Sprayed coatings of boride nitride did not effectively lubricate the fabric. Static heat treatment tests at 950 C indicate that the fabric is chemically attacked by large quantities of silver, CaF2, and boron nitride. Sputtered films or powder impregnation of the fabric with gold may provide adequate lubrication up to 1000 C without showing any chemical attack. Author

**N88-18727#** Allied Bendix Aerospace, Kansas City, Mo.
**EVALUATION OF CENTRIFUGAL BARREL TUMBLING PROCESS FOR IMPREGNATION OF MOLYBDENUM DISULFIDE POWDER LUBRICANT**
G. D. White Feb. 1987 14 p
(Contract DE-AC04-76DP-00613)
(BDX-613-3698) Avail: NTIS HC A03/MF A01

Molybdenum disulfide lubricant, applied by the moly-harperizing process, was evaluated in terms of film thickness, effects of cleaning operations, effects on the weldability of stainless steel, and determination of the optimum application variables. The results of this evaluation show molybdenum disulfide to be a film of measurable thickness having a very low coefficient of friction which is affected by substrate finish and cleaning operations. Author

**N88-18728#** Argonne National Lab., Ill.
**APPLICATION OF X-RAY COMPUTED TOMOGRAPHY TO CERAMIC/CERAMIC COMPOSITES**
W. A. Ellingson, M. W. Vannier, and D. P. Stinton Jul. 1987 25 p Presented at the Symposium on Characterization of Advanced Materials, Monterey, Calif., 27 Jul. 1987 Prepared in cooperation with ORNL, Tenn.
(Contract W-31-109-eng-38)
(DE88-002903; CONF-8707132-2) Avail: NTIS HC A03/MF A01

A computed tomographic imaging system has been given an initial evaluation for the ability to detect voids and characterize fiber orientation in ceramic composites consisting of SiC fibers in a matrix of chemical vapor infiltrated SiC. Specimens with various fiber loadings and different final densities, fabricated from random chopped fibers, continuous unidirectional fibers, and layups of various cloth types were examined. Specimens in various early stages of processing were also examined to see if the presence of a graphite fixture (used in the CVI process) caused image degradation. Results show that the CT images are able to discriminate among fabric weaves and show major fabric-weave characteristics prior to SiC impregnation, after impregnation to at least 85 percent of theoretical density, and in the presence of a graphite holder. However, with the currently available 100-micron pixel size and implementation of zoom features, individual voids on the order of 200 microns cannot be detected. DOE

**N88-18729#** Lawrence Livermore National Lab., Calif.
**CRYSTALLIZATION AND GLASS FORMATION IN ELECTRON AND LASER BEAM IRRADIATED Cu-Zr ALLOYS**
J. S. Huang, E. N. Kaufmann, M. A. Wall, and B. L. Olsen Nov. 1987 9 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract W-7405-eng-48)
(DE88-003390; UCRL-96793; CONF-871124-32) Avail: NTIS HC A02/MF A01

Four Cu-Zr alloys, Cu56Zr44, Cu50Zr50, Cu47Zr53, and Cu33Zr67, were surface melted with electron and pulsed laser beams to compare their kinetics of nucleation, growth and glass formation. It was observed that the ease of glass formation increased in the order: Cu33Zr67, Cu47Zr53, Cu56Zr44, and Cu50Zr50. The nucleation and regrowth produced different metastable phases. At the equiatomic composition, the preferred phase is a CsCl-type (B2) BCC structure. As the composition deviates from this, the preferred phase is either orthorhombic or tetragonal with a much larger unit cell not previously reported in the literature. The maximum growth velocity of these metastable phases was found to be about 0.025 m/s. The slow kinetics are responsible for the ease of glass formation in these systems. DOE

**N88-18730#** Oak Ridge National Lab., Tenn.
**CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROGRAM DATA BASE**
M. K. Booker Dec. 1987 6 p Presented at the 25th Automotive Technology Development Contractor's Coordination Meeting, Dearborn, Mich., 26 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003922; CONF-8710116-4) Avail: NTIS HC A02/MF A01

A large amount and wide variety of data on the behavior of advanced ceramic materials is currently being generated within the Ceramic Technology for Advanced Heat Engines Program. This paper summarizes efforts to date to develop a computer data base system for the management of those data. The system is based on the use of desktop microcomputers, which provides a maximum of efficiency, economy, and convenience in the operation of the system. DOE

**N88-18731#** Oregon State Univ., Corvallis.
**PERTURBED ANGULAR CORRELATIONS IN ZIRCONIA CERAMICS Annual Progress Report No. 3**
J. A. Gardner 1987 13 p
(Contract DE-FG06-85ER-45191)
(DE88-004117; DOE/ER-45191/4) Avail: NTIS HC A03/MF A01

Research on zirconia and yttrium alloys is presented. Perturbed Angular Correlations (PAC) have been made with Hf-181, In-111 as probes. Also, PAC spectra of Hf-181/Ta-181) in cubic zirconia/yttria are presented at several temperatures. Information is also presented on initial experiments of PAC research on pure zirconia using In/Cd. DOE

**N88-18732#** California Univ., Davis. Dept. of Mechanical Engineering.
**CERAMIC DECOMPOSITION UNDER IRRADIATION Progress Report**
D. G. Howitt 1987 10 p
(Contract DE-FG03-86ER-45279)
(DE88-004327; DOE/ER-45279/T1) Avail: NTIS HC A02/MF A01

Quantitative determinations of the decomposition of thin film and bulk ceramic materials during electron microscopy has shown that the radiation damage effect is a complex one depending on the dielectric properties. In low-melting-temperature glasses, for example, much of the activity is due to field enhanced diffusion of low atomic weight species. This is particularly true of bulk specimens and for the case of binary soda-borosilicate glass the sodium depletion in the SEM can be quantitatively described in terms of this effect. Studies with thin specimens of refractory carbides show that in these materials the carbon depletion is due to direct displacement processes and that here the electric fields give rise to recombination effects. The studies of ceramic thin

films suitable for reference standards is continuing as a joint effort with the Rockwell Science Center. Work is in progress to describe the in-plane crystallization that is observed in terms of the latent heat involved and the configurational entropy of the propagating interface. DOE

**N88-18733#** Pacific Northwest Labs., Richland, Wash.
**NUCLEATION AND GROWTH OF CALCIUM CARBONATE CRYSTALS ON SURFACE-MODIFIED POLYETHYLENE AND POLYSTYRENE**
P. C. Rieke Oct. 1987 7 p Presented at the Conference on Atomic and Molecular Processing of Electronic and Ceramic Materials: Preparation, Characterization and Properties, Seattle, Wash., 31 Aug. 1987
(Contract DE-AC06-76RL-01830)
(DE88-005126; PNL-SA-15180; CONF-870878-2) Avail: NTIS HC A02/MF A01

Bone, tooth, and seashell are fracture-resistant, low-temperature derived ceramic/polymer composites which utilize inexpensive ceramic materials. By understanding how these composites are formed, man-made ceramic/polymer composites with similar or superior properties can be produced. The formation of calcified tissue in living organisms is controlled by the surface properties of the protein polymeric matrix undergoing calcification. Common polymers may also function as a suitable surface for crystal growth provided the surface can mimic the behavior of its natural protein counterpart. Polyethylene and polystyrene surfaces were chemically modified by chromic acid and sulfuric acid etching. The degree of modification was varied, and the rate and density of crystal nucleation and growth were monitored. DOE

**N88-18734*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OXIDATION AND PROTECTION OF FIBERGLASS-EPOXY COMPOSITE MASTS FOR PHOTOVOLTAIC ARRAYS IN THE LOW EARTH ORBITAL ENVIRONMENT**
Sharon K. Rutledge, Phillip E. Paulsen, Joyce A. Brady (Cleveland State Univ., Ohio.), and Michael L. Ciancone 1988 12 p Presented at the Spring Meeting of the Materials Research Society, Reno, Nev., 5-9 Apr. 1988
(NASA-TM-100839; E-4027; NAS 1.15:100839) Avail: NTIS HC A03/MF A01 CSCL 11B

Fiberglass-epoxy composites are considered for use as structural members for the mast of the space station solar array panel. The low Earth orbital environment in which space station is to operate is composed mainly of atomic oxygen, which has been shown to cause erosion of many organic materials and some metals. Ground based testing in a plasma asher was performed to determine the extent of degradation of fiberglass-epoxy composites when exposed to a simulated atomic oxygen environment. During exposure, the epoxy at the surface of the composite was oxidized, exposing individual glass fibers which could easily be removed. Several methods of protecting the composite were evaluated in an atomic oxygen environment and with thermal cycling and flexing. The protection techniques evaluated to date include an aluminum braid covering, an indium-tin eutectic and a silicone based paint. The open aluminum braid offered little protection while the CV-1144 coating offered some initial protection against atomic oxygen, but appears to develop cracks which accelerate degradation when flexed. Coatings such as the In-Sn eutectic may provide adequate protection by containing the glass fibers even though mass loss still occurs. Author

**N88-18735#** Fraunhofer-Inst. fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (West Germany).
**QUALITY ASSURANCE OF CERAMIC MATERIALS AND GAS TURBINE COMPONENTS Final Report [QUALITAETSSICHERUNG KERAMISCHER WERKSTOFFE UND KOMPONENTEN DER GASTURBINE]**
H. Reiter 4 Mar. 1985 47 p In GERMAN
(IzfP-850303-TW; ETN-88-91051) Avail: NTIS HC A03/MF A01

Nondestructive tests were performed on ceramics to assess loading capacity and acceptability. The four-point bending samples were made of reaction-bonded silicon nitride, sintered silicon nitride, and sintered silicon carbide with artificial defects (pores, impurities). The bending samples were characterized using ultrasonic and microfocus X-ray tests. The ultrasonic tests show differences between series of the same material. The series with higher sound speed tend to have higher bending strength. The defects were determined within 100 microns using ultrasonic microscopy and microfocus X-rays. Large Fe-parts behave differently in the three materials. Small Fe-parts (smaller than 200 microns) behave as a pore for all three materials. The fracture-mechanical results confirm the danger of defects close to the surface (for bending loads), requiring an intensive nondestructive surface testing. ESA

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N88-18736#** Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
**STANDARDIZATION OF LUBRICITY TEST Interim Report, Nov. 1985 - Nov. 1986**
T. B. Biddle, R. J. Meehan, and P. A. Warner Aug. 1987 37 p
(Contract F33615-85-C-2508)
(AD-A187776; PW/GPD-FR-19031-1; AFWAL-TR-87-2041) Avail: NTIS HC A03/MF A01 CSCL 11H

Since the early 1960s the Ball-on-Cylinder Lubricity Evaluator (BOCLE) test has been recognized as the best available method for providing a relative system of measurement of the lubricity properties of jet engine fuels. The technical effort described in this report was directed at refining and standardizing the (BOCLE) test. It focused on identifying variables suspected of affecting test method precision. The Falex Ring was shown to significantly enhance BOCLE test precision and eliminate many of the problems associated with the conventional AMS 6444 test cylinder. Test results showed that the source of the test ball can have a significant effect on BOCLE test results. SKF Swedish precision balls were found to provide optimum batch to batch consistency. Isopar M + 30 ppm DuPont DCI-4A was shown to be a reproducible fluid suitable for use as a standard reference fluid for BOCLE testing. GRA

**N88-18737#** Environmental Research Lab., Gulf Breeze, Fla.
**DEGRADATION OF JET AND MISSILE FUELS BY AQUATIC MICROBIAL COMMUNITIES Final Report, Oct. 1982 - Oct. 1984**
P. H. Pritchard, L. H. Mueller, J. C. Spain, and A. W. Bourguin Jul. 1987 175 p
(Contract MIPR-N82-12; AF Proj. 1900)
(AD-A188065; AFESC/ESL-TR-86-59) Avail: NTIS HC A08/MF A01 CSCL 06M

The fate of jet fuel (JP-4) in aquatic sediments was studied concomitantly in laboratory test systems and in the field. Sediments from an estuarine pond were dosed with jet fuel and then reapplied to the pond as well as into plexiglass trays on the sediment bed and quiescent bottle tests in the laboratory. Thirty-three selected hydrocarbons in the jet fuel were followed chemically to quantitate relative hydrocarbon losses. Several hydrocarbons which biodegraded or rapidly volatilized in the bottle tests, were much slower to disappear in the field and the plexiglass trays. In general, mixing of the jet fuel with sediments increased the persistence of the associated hydrocarbons. The fate of missile fuels in aquatic systems was also investigated. The high density missile fuels RJ-5 and JP-9 resisted biodegradation when incubated with water/sediment suspensions collected from aquatic habitats. RJ-5 and JP-9 were not toxic to the microbial communities at

concentrations of 400 mg per liter, but RJ-5 was toxic to Mysidopsis bahia in 96-hour acute tests (LC50 88 micrograms/liter). GRA

**N88-18738#** Sandia National Labs., Albuquerque, N. Mex. Fluid and Thermal Sciences Dept.
**AN ELECTRO-OPTIC EXPLOSIVE IGNITER**
D. A. Benson and B. H. Rose Dec. 1987 51 p
(Contract DE-AC04-76DP-00789)
(DE88-004728; SAND-87-2597) Avail: NTIS HC A04/MF A01

This report presents studies of a new concept for igniting an explosive device solely by means of an optical link with the firing system. The concept combines a new low-energy thermal igniter device, the semiconductor bridge (SCB), with new compact series photovoltaic arrays and hybrid microcircuit technology in a device to meet increased safety and security objectives. This approach provides an alternative to direct laser ignition, in increasing safety through optical coupling. We discuss the capabilities and limitations of this approach, as well as our experience with discrete component prototypes. We describe tests conducted with a variety of secondary explosives to illustrate the concept and measure the available device function times. DOE

# 29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

**N88-18739*#** Texas Univ., Austin.
**INVESTIGATION OF SURFACE TENSION DRIVEN CONVECTION AS A FEASIBILITY STUDY FOR A MICRO-GRAVITY EXPERIMENT Final Report**
E. L. Koschmieder Mar. 1988 64 p
(Grant NAG3-393)
(NASA-CR-182504; NAS 1.26:182504) Avail: NTIS HC A04/MF A01 CSCL 22A

The work performed for the feasibility study of a microgravity surface tension driven convection experiment was reviewed. An experimental investigation of the onset of convection in shallow fluid layers heated uniformly from below and cooled from above by an air layer was made. Results are discussed in relation to the formation of Benard cells. The onset of Rayleigh-Benard convection in thin fluid layers heated uniformly from below were studied experimentally. It was found that in thin fluid layers the onset of Rayleigh-Benard convection is preceded by subcritical convective motions. Secondly, it was found that the onset of Rayleigh-Benard convection in non-Boussinesq fluid layers takes place in the form of hexagonal cells at Rayleigh numbers larger than the critical Rayleigh number R sub C = 1708 which determines the onset of convection in Boussinesq fluid layers. B.G.

**N88-18740*#** Clemson Univ., S.C.
**LUNAR FIBERGLASS: PROPERTIES AND PROCESS DESIGN**
Robert Dalton and Todd Nichols 29 Jul. 1987 35 p
(Grant NGT-80001)
(NASA-CR-182580; NAS 1.26:182580) Avail: NTIS HC A03/MF A01 CSCL 22A

A Clemson University ceramic engineering design for a lunar fiberglass plant is presented. The properties of glass fibers and metal-matrix composites are examined. Lunar geology is also discussed. A raw material and site are selected based on this information. A detailed plant design is presented, and summer experiments to be carried out at Johnson Space Center are reviewed. Author

**N88-18741#** Oak Ridge National Lab., Tenn.
**EXPERIMENTAL INVESTIGATION OF LOW GRAVITY TWO-PHASE FLOW BEHAVIOR**
G. L. Yoder, Jr., E. D. Brewer, J. E. Hardy, W. B. Jatko, and R. N. Nodine 1987 24 p Presented at the International Symposium on Thermal Problems in Space-based Systems, Boston, Mass., 13 Dec. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003779; CONF-871252-1) Avail: NTIS HC A03/MF A01

An experiment is being developed to investigate two-phase flow and heat transfer behavior under the microgravity conditions of space. The experiment is designed to be carried out utilizing the NASA standard Get Away Special (GAS) canister to be flown on a future space shuttle flight. The experiment contains a full two phase flow boiling loop and will determine the effect of microgravity conditions on nucleate boiling heat transfer and critical heat flux values as well as examine liquid/vapor separation processes. This paper describes the experiment designed to be flown on the shuttle and a similar ground test loop presently being operated. In addition, initial data from the ground system is presented. DOE

**N88-18742*#** Teledyne Brown Engineering, Huntsville, Ala.
**MICROGRAVITY AND MATERIALS PROCESSING FACILITY STUDY (MMPF): REQUIREMENTS AND ANALYSES OF COMMERCIAL OPERATIONS (RACO) PRELIMINARY DATA RELEASE**
3 Mar. 1988 693 p
(Contract NAS8-36122)
(NASA-CR-179309; NAS 1.26:179309) Avail: NTIS HC A99/MF E03 CSCL 12A

This requirements and analyses of commercial operations (RACO) study data release reflects the current status of research activities of the Microgravity and Materials Processing Facility under Modification No. 21 to NASA/MSFC Contract NAS8-36122. Section 1 includes 65 commercial space processing projects suitable for deployment aboard the Space Station. Section 2 contains reports of the R:BASE (TM) electronic data base being used in the study, synopses of the experiments, and a summary of data on the experimental facilities. Section 3 is a discussion of video and data compression techniques used as well as a mission timeline analysis. Author

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

**N88-18743#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
**EXPERIMENTAL SET-UP AND MATHEMATICAL MODELING OF H-SHAPED BEAM TYPE STRUCTURE M.S. Thesis**
Allen K. Jarrell 1986 48 p
(AD-A187196; AFIT/CI/NR-87-82T) Avail: NTIS HC A03/MF A01 CSCL 13M

An experimental set up for a flexible H-beam type structure is designed to demonstrate flexible body maneuvers. The equations of motion for the structure are developed using the finite element method. The H-beam is sized by looking at the structural flexibility in the system's response. Specifications necessary for the hardware used in the experiment are given. GRA

**N88-18744#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**MECHANISMS IN THERMAL MECHANICAL FORMING OF PLATES M.S. Thesis**
Hiram A. Malaret May 1987 90 p
(Contract N00228-85-G-3262)
(AD-A187797) Avail: NTIS HC A05/MF A01 CSCL 11F

The angular deflection produced by flame line heating as plate dimensions are varied, specifically in the direction of heating, is examined. The behavior is found to be similar to that observed when the line of heating approaches a plate edge and the bending, in both cases, can be obtained from the same parametric curve. The parameter values defining these curves are related to process variables: the thermal power and speed of travel of the heat source. Additionally, the in-plate variation in bending is characterized. The application of these findings to the formulation of a bending prediction model that incorporates plate dimensions as well as

location of the heating line is presented. The extension of this model to predict bending at specific locations within the plate is discussed, and recommendations for further research are made.
GRA

**N88-18745#** TRW Space Technology Labs., Redondo Beach, Calif.
**CRYOCOOLER SYSTEMS DEMONSTRATION Final Report, 4 Sep. 1984 - 23 Feb. 1986**
R. D. Sandell and A. H. Silver 31 Aug. 1987 25 p
(Contract N00014-84-C-0397)
(AD-A188025) Avail: NTIS HC A03/MF A01 CSCL 13A

TRW successfully transferred Stirling-cycle cryocooler technology from its development at NBS to industry. We installed, modified, and operated a small, plastic, five-stage Stirling cycle refrigerator which was developed at the National Bureau of Standards and furnished to TRW for this project. We also designed and fabricated a new gas handling system, pressure wave generator and displacer drive, and fiber-designed, fabricated, and operated a monolithic thin film SQUID gradiometer on a single silicon chip. The cooler was modified by the addition of a 4 Kelvin Joule-Thompson stage before delivery to TRW and we initially fabricated this SQUID with a Nb-Pb technology for 4 Kelvin experiments. We later transferred to an all-niobium technology developed at TRW when it was decided to operate the cryocooler at about 7 Kelvin without the Joule-Thomson stage. We designed, constructed, and installed all components necessary to interface the magnetometer with the silicon printed circuit board which was heat-sunk to the final stage of the cryocooler. Radiation shields were constructed and low noise and low thermal electrical leads were provided.
GRA

**N88-18746#** Pacific Northwest Labs., Richland, Wash.
**SLIP CASTING OF ADVANCED CERAMICS AND COMPOSITES**
C. H. Schilling and I. A. Aksay Mar. 1987 21 p Presented at the 3rd Workshop of the Canadian Industry/University Council on Advanced Ceramics, Montreal, Quebec, 25 Feb. 1987 Prepared in cooperation with Washington Univ., Seattle
(Contract DE-AC06-76RL-01830)
(DE88-003424; PNL-SA-14696; CONF-8702120-1) Avail: NTIS HC A03/MF A01

Particle packing arrangements in slip cast (colloidal filtration) articles uniquely affect the evolution of grain size and porosity defect distributions during sintering. These particle packing arrangements are influenced by the physical properties of colloidal structures in suspension and the resulting processes of agglomerate restructuring and pore closure during consolidation. Key parameters affecting cast layer packing structures are the particle size distribution, interparticle potential, hydrodynamic stresses in suspensions, and the combined effect of hydrodynamic and compaction stresses in cast layers. Experiments with electrostatically stabilized aqueous alumina systems illustrate specific effects of interparticle potential on slip casting rates and microstructure evolution during sintering. In addition, experiments were conducted that illustrate microstructure variations caused by differential sedimentation velocities and agglomerate growth kinetic effects.
DOE

**N88-18747#** Technical Research Centre of Finland, Espoo.
**RESEARCH FIELD OF FIRE TECHNOLOGY IN FINLAND**
P. Loikkanen and C. Holm Feb. 1987 68 p In FINNISH
(DE88-751094; VTT-TIED-682) Avail: NTIS (US Sales Only) HC A04/MF A01

The goal of the study is to give an overview of the whole diversified research field of fire technology and its problems. For this reason the research subjects have been grouped so that the responsibilities of different authorities, the legislation and specifications, various fields of technology, areas of industry, and groups of products could all be found as clearly as possible. The field has been divided into nine sub-areas. They are: general grounds, fire physics and chemistry, structural fire prevention, textiles and furnishings, devices for heating and other use, detection, fire fighting and rescue, quality control, and special problems. The sub-areas have been divided into 34 main subjects and these, excluding those of special problems, further into as many as 117 subject groups. Characteristics and problems of the sub-areas and the main subjects have been described. The subject groups have been characterized by key words and concepts which outline the projects. No concrete research projects and programs have, however, been directly suggested because their extent and contents depend essentially on financing and other available resources.
DOE

**N88-18748#** Technical Research Centre of Finland, Espoo.
**FIRE TESTS ON LOOSE-FILL INSULATION MATERIALS**
M. Kokkala Jun. 1987 81 p
(DE88-751182; VTT-TUTK-485) Avail: NTIS (US Sales Only) HC A05/MF A01

A short review of the physical and chemical processes involved in smouldering fires of loose-fill insulation materials is presented. Various official and inofficial fire test methods are described and evaluated. Results of a series of tests made to evaluate the British Standard BS 5803:Part 4:1985 are presented. A proposal for a Nordtest method based on this standard is given as an appendix.
DOE

**N88-18749#** Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
**SIZE-REDUCTION AND SORTING BEHAVIOR IN SIEVE HAMMER MILLS Ph.D. Thesis [ZERKLEINERUNGS- UND KLASSIERVERHALTEN IN SIEBHAMMERMUEHLEN]**
Harald Schallnus 1987 182 p In GERMAN Sponsored by Deutsches Forschungsgemeinschaft, West Germany
(ETN-88-91480) Avail: NTIS HC A09/MF A01

Experiments were performed in a continuously operating sieve hammer mill to determine the duration of presence of the material to be ground in the size reduction machine. The test stand, analysis techniques, evaluation methods, and selection and production of samples are described. It is shown that the duration of presence of the material in the grinding space of the mill is approximately comparable to that in an ideal mixer. The type of sieve casing has an essential effect on the duration of presence. A combined model for the description of the size reduction and sorting behavior which allows the determination of the process coefficients (size reduction speed, sorting speed, mass transition coefficient) and their dependence on the different parameters, was developed.
ESA

**N88-18750#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**DEVELOPMENT OF THE EXTENDABLE AND RETRACTABLE MAST (ERM), DESIGN PHASE 2. VOLUME 1 Final Report**
Specht, Schmid, Chellingsworth, Wislez, Bhatti, and Stenne (Societe Anonyme Belge de Constructions Aeronautiques, Brussels, Belgium ) Paris, France ESA 6 Mar. 1987 292 p Original contains color illustrations
(Contract ESTEC-5676/83-NL-AN(SC))
(RP-2010-0000-DS/09; ESA-CR(P)-2481; ETN-88-91697) Avail: NTIS HC A13/MF A01

An Extendable and Retractable Mast (ERM) for space applications such as deployment and retraction of high power rollable, foldable, or rigid solar arrays, large unfurlable antennas, and scientific payloads, was developed. The coverage of a large field of application requires a strong and stiff light-weight mast with good pointing accuracy allowing the adaptation of heavy tip masses as well as the fixation of line-loads to intermediate attachment points along the mast at the same time. The ERM payload capability is 40 kg on tip, plus 10 kg/m line load, plus 100N eccentric load. Deployed length is 40 m. The ERM is designed as a spindle-driven telescopic mast in carbon-fiber reinforced plastics (CFRP) technology. A 40 m solar array mast and a 20 m antenna mast were considered. The feasibility of a 60 m mast is also shown. Manufacturing and test of a breadboard model hardware, and the detailed design of an engineering model mast are described.
ESA

**N88-18751*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**FURTHER DEVELOPMENTS IN EXACT STATE RECONSTRUCTION IN DETERMINISTIC DIGITAL CONTROL SYSTEMS**
Michael E. Polites Mar. 1988 19 p
(NASA-TP-2812; NAS 1.60:2812) Avail: NTIS HC A03/MF A01 CSCL 13B

A more general version of the ideal state reconstructor for deterministic digital control systems previously developed is presented. In the original version, measurements prefiltered by a multi-input/multi-output moving-average (MA) process were utilized in the state reconstruction process. In this version, the MA-prefiltered measurements can be supplemented by standard instantaneous measurements. The ideal state reconstructor is so named because: if the plant parameters are known exactly, its output will exactly equal the true state of the plant, not just approximate it. Furthermore, it adds no additional states or eigenvalues to the system. Nor does it affect the plant equation for the system in any way; it affects the measurement equation only. An example is presented which illustrates the procedure for choosing the parameters in it. Author

**N88-18752#** Allied Bendix Aerospace, Kansas City, Mo.
**EVALUATION OF SOLDER FLUX SOLVENTS IN A VAPOR-DEGREASING APPLICATION FOR HYBRID MICROCIRCUITS Final Report**
B. E. Adams Jan. 1987 23 p
(Contract DE-AC04-76DP-00613)
(BDX-613-3638) Avail: NTIS HC A03/MF A01

Vapor degreasing hybrid microcircuits with an azeotropic mixture of trichlorotrifluoroethane and methanol; an azeotropic mixture of trichlorotrifluoroethane, hexane, and methyl chloride; and 1,1,1 trichloroethane was evaluated to find a replacement for cold-cleaning with the more toxic trochloroethylene. Vapor degreasing reduces solvent usage, and replacing trichloroethylene would reduce potential health risks within the microelectronics department. From visual inspection and Meseran number it was determined that vapor degreasing with 1,1,1 trochloroethane could be an acceptable replacement process. Author

**N88-18753#** Lawrence Livermore National Lab., Calif.
**ENGINEERING THRUST AREAS, 1988**
1988 32 p
(Contract W-7405-eng-48)
(DE88-005103; UCID-20366-88) Avail: NTIS HC A03/MF A01

This volume is a compilation of major research areas of the Engineering Research Program at Lawrence Livermore Laboratory. Topics included are: (1) computer studies of electromagnetic problems, (2) application of the finite element method to mechanical engineering, (3) microelectronics, (4) fabrication technology, (5) pulsed power equipment, (6) nondestructive testing, and (7) remote sensing. DOE

**N88-18754#** Joint Publications Research Service, Arlington, Va.
**JPRS REPORT: SCIENCE AND TECHNOLOGY. EUROPE AND LATIN AMERICA**
26 Jan. 1988 40 p
(JPRS-ELS-88-003) Avail: NTIS HC A03/MF A01

Articles from the popular and trade press of Western Europe and Latin America are presented on advanced materials, aerospace and civial aviation, computers, defense industries, factory automation and robotics, lasers, senors, optics microelectronics, science and technology policy, biotechnology, marine technology, and nuclear developments. The aerospace articles include an overview of Austrian space activities and plans and a report on a panel of West German experts recommending against self-sufficiency for the Airbus. J.P.B.

**N88-18755#** Joint Publications Research Service, Arlington, Va.
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA**
29 Jun. 1987 111 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-029) Avail: NTIS HC A06/MF A01

Open literature articles and summaries are presented on the following topics: aerospace science, applied sciences, national developments, and scientific organizations. For individual titles, see N88-18756 through N88-18761.

**N88-18756#** Joint Publications Research Service, Arlington, Va.
**CHINESE 7760 CAD/CAMM SOFTWARE SYSTEM INTRODUCED** **c61**
Xuexun Zhao *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 1-7 Transl. into ENGLISH from Guoji Hangkong (International Aviation) (Beijing, China), no. 4, Apr. 87 p 2-4, 58 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

A computer-aided aircraft design, manufacturing and management system is described. The system has applications in parameter selection, overall aircraft design, design of aircraft profile, analysis of aerodynamics characteristics, structural design, structural analysis, contstruction of modal lines, computer-aided manufacturing, and computer-aided production planning and management. In the prototype design of typical parts of an aircraft, this system can improve the design efficiency by a factor of 5 to 6 compared to traditional methods. Compared to other numerical control software, the design cycle can be reduced by at least a factor of 3, and the design efficiency can be increased by a factor of 5 to 6. Where it once took 2 to 3 days to compile a monthly plan for a shop, it now takes only several minutes. J.P.B.

**N88-18757#** Joint Publications Research Service, Arlington, Va.
**IMPROVED BACKFIRE ANTENNA USING CIRCULAR DIPOLE** **c32**
Ximing Song, Ruihua Li, Yufeng Zhang, and Boliang Rao *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 10-13 Transl. into ENGLISH from Dianzi Kexue Xuekan (Journal of Electronics) (Beijing, China), v. 9, no. 1, Jan. 1987 p 82-84 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

An experimental study on a backfire antenna using a circular dipole showed that, as compared to a short linear backfire antenna, its gain (15.2 dB) decreased by approximately 3 dB and its longitudinal dimension increased by about 0.5 lambda. However, its lateral dimension is only approximately 1/4 that of a short backfire antenna. Based on this information, rough estimations are made for a short linear backfire antenna. When the lateral dimension is decreased to 1/4 the original size, the area of the main reflector is reduced to 1/16 of the original size. The gain should be decreased by approximately 2 dB. The increase in longitudinal length by one-fold increases the gain by about 3 dB. Thus, the total gain is approximately 6 dB. The gain of the antenna tested is about 12 dB; therefore, it is more efficient. This is not achievable by a lambda/4 length linear dipole backfire antenna. The key to the success of this antenna is the optimization of the design of the circular dipole antenna and the adjustment cup. Author

**N88-18758#** Joint Publications Research Service, Arlington, Va.
**OPERATION OF ELECTRON-BEAM CONTROLLED CO2 LASER AT 6 ATMOSPHERES** **c36**
Wuming Guo, Hongyao Yang, Jianwei Wang, Yizhuang Xu, and Nianle Wu *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 14-21 Transl. into ENGLISH from Guangxue Xuebao (Acta Optica Sinica), (Shanghai, China), v. 7, no. 2, Feb. 1987 p 120-125 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

The properties of a CO2 laser controlled by an electron beam and operating under a pressure of 6 atmospheres are reported. The discharge characteristics and tunability of the laser were studied. The laser structure is described in detail as well as the process for determining the laser wavelength. J.P.B.

**N88-18759#** Joint Publications Research Service, Arlington, Va.
**OBSERVATIONS AND ANALYSES OF SUMMER WHISTLERS AT THE GREAT WALL STATION OF ANTARCTICA Abstract Only** **c46**
Changming He *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 22 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica) (Beijing, China), v. 30, no. 2, Mar. 1987 p 109-118 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

Whistler and VLF emission observations were carried out for 37 days. Based on statistical analyses of the observed data, whistler types, occurrence and dispersion characteristics of whistlers are described. Emphasis is placed on the detailed analysis of typical whistlers during and after a magnetic storm. The electron density variation corresponding to the propagation path is deduced. It is found that during the storm the depletion of the plasmasphere and the subsequent refilling process from the ionosphere occurs. The results show that the downward depletion flux is 10 to the 9th el/sq cm-sec and upward refilling flux is 5 x 10 to the 8th el/sq cm-sec. Author

**N88-18760#** Joint Publications Research Service, Arlington, Va.
**EVOLUTION OF ACOUSTIC GRAVITY WAVE PACKET IN SPATIALLY AND TEMPORALLY VARYING WIND Abstract Only** **c46**
Fan Yi, Baixian Liang, and Jun Li *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 23 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica), (Beijing, China), v. 30, no. 7, Mar. 1987 p 119-127 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

Starting from compressible hydrodynamic equations and using the multiple scale and Wentzel Kramers Brillouin (WKB) methods, the authors have investigated the evolution process of an acoustic gravity wave (AGW) packet in a spatially and temporally varying wind. The evolution equations of wavelength, phase velocity, propagation direction and amplitude of the AGW packet are derived. It is shown that the variations of wavelength, phase velocity and propagation direction depend on the spatial and temporal variation of the wind and also on the direction of the wave packet with respect to the wind. By analyzing the evolution equation of the amplitude, the authors found that the wave action of AGW is conserved in the spatially and temporally slowly varying wind. Further analysis shows that an increase in the packet energy is accompanied by an increase in the wave frequency, while a decrease in the packet energy is accompanied by a decrease in the wave frequency. The cause of the packet energy variation is wave-flow interaction produced by temporal variation of the wind. Author

**N88-18761#** Joint Publications Research Service, Arlington, Va.
**TEMPORAL EVOLUTION OF IONOSPHERIC ELECTRIC FIELD DRIVEN BY FIELD-ALIGNED CURRENT Abstract Only** **c46**
Youmin Guo *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 24 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica), (Beijing, China), v. 30, no. 7, Mar. 1987 p 128-135 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

Based on a simple Senior-Blanc's time-dependent model and using a step-varying field-aligned current instead of the potential as the driving force, the temporal evolution of the ionospheric electric field is discussed. It is shown that configurations in both cases are similar--the relaxation time toward the steady state is about 50 minutes in both cases. However, there are some differences between them: under current driving situations, the potential at the boundary of the polar cap is not constant but decreases exponentially toward the steady state; at the auroral zone the difference between the steady state and the initial time electric fields is very small. In addition, the steady state value of the second field-aligned current calculated from the model is even closer to the observed value. The latitudinal variation of the potential is steeper, and the maximum potential appears earlier. The calculated shielding factor and the shielding time constant show that the shielding effect under the current driving situation seems stronger than that in the potential driving case. Author

**N88-18762#** Texas A&M Univ., College Station. Engineering Research Center.
**PROCEDURES FOR QUANTITATIVE SENSITIVITY AND PERFORMANCE VALIDATION STUDIES OF A DETERMINISTIC FIRE SAFETY MODEL Ph.D. Thesis**
Nadir Khoudja Mar. 1988 153 p
(Grant NBS-70NANB6H-619)
(NBS/GCR-88/544) Avail: NTIS HC A08/MF A01

The increasing number of users of fire models demands their validation by a third party team to investigate the reliability of the models with respect to concerns of potential users. Due to insufficient documentation of the subject fire model, verification of it was limited and informal. However, quantitative and detailed procedures for sensitivity study and performance validation were applied. A deterministic model, predicting fire behavior in structure, was selected to illustrate partial model assessment procedures. The development and application of two generic methodologies for sensitivity analysis and performance validation are described. The subject fire model is FAST from which 16 input parameters were selected for sensitivity analysis study. Comparative Graphical Results are illustrated over simulation time for the input parameters. Author

# 32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

**N88-18763#** National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
**INVESTIGATION OF A RAY-MODE REPRESENTATION OF THE GREEN'S FUNCTION IN A RECTANGULAR CAVITY**
D. I. Wu and D. C. Chang Sep. 1987 48 p Prepared in cooperation with Colorado Univ., Boulder
(PB88-131677; NBS/TN-1312) Avail: NTIS HC A03/MF A01; also available SOD HC $2.50 as 003-003-02832-1 CSCL 20N

It is known that a point-source excited field in a rectangular cavity can be represented either in terms of summation of modes or in terms of rays produced by the equivalent image sources. Both representations involve series that are slowly convergent, so computation of fields inside the cavity is difficult. To obtain a numerically efficient scheme, a hybrid ray-mode representation is developed using the finite Poisson summation formula. The modal representation is modified in such a way that all the modes near resonance are retained while the truncated remainder of the mode series is expressed in terms of a weighted contribution of rays. For a large cavity, the contribution of rays from far away images becomes small, therefore the ray sum can be approximated by one or two dominant terms without a loss of numerical accuracy. To illustrate the accuracy and the computational simplification of this ray-mode representation, numerical examples are included with the conventional mode series (summed at the expense of long computation time) serving as a reference. GRA

**N88-18764#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**AIR FORCE INSTITUTE OF TECHNOLOGY (AFIT) LOCAL AREA NETWORK (LAN) PERFORMANCE EVALUATION MODEL: AN ANALYTIC MODEL FOR ASSESSING THE IMPACT OF CHANGING LAN HARDWARE AND SOFTWARE CONFIGURATIONS M.S. Thesis**
Alan B. Tucker, Jr. Sep. 1987 77 p

(AD-A187191; AFIT/GSM/LSMA/87S-34) Avail: NTIS HC A05/MF A01 CSCL 12G

The purpose of this study was to develop a performance evaluation model to analyze the impact of changing hardware and software configurations on a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) based on local area network (LAN). The analysis focuses on the specific network software and computing equipment used on the Air Force Institute of Technology (AFIT) LAN. The analysis was accomplished in two parts. First, a functional model of the network was prepared using available technical documentation and by consulting with system experts. The second part of the process was performance modeling. Individual traffic loading models were developed for each device to be connected to the AFIT LAN. Packet sizes characteristic of the networking software and access method were then specified for each device, and an aggregate data rate for each device was computed. Three performance measures: maximum channel efficiency, throughput, and minimum average delay were then selected to evaluate overall network performance. A standard spreadsheet program was used to construct the model. The results of the modeling analysis indicate the AFIT LAN will meet the school's expanding networking requirements. GRA

**N88-18765#** Southern Methodist Univ., Dallas, Tex. Dept. of Electrical Engineering.

**SPREAD SPECTRUM MOBILE RADIO COMMUNICATIONS Interim Scientific Report, 1 Mar. - 30 Sep. 1987**

S. C. Gupta 30 Sep. 1987 35 p

(Grant AF-AFOSR-0309-82)

(AD-A187487; AFOSR-87-1645TR) Avail: NTIS HC A03/MF A01 CSCL 25B

This report considers packet radio performance in mobile fading channels. The first chapter considers the optimal packet size for NPCSMA scheme in mobile fading channels. Here, modified expression for the channel throughput of nonpersistent carrier sense multiple access protocol (NPCSMA) in slow Nakagami fading channel is given. The optimal packet size and the acknowledgement size are obtained such that a maximum number of users can share the channel while maintaining reliable values for both the probability of packet and acknowledgement error. Meanwhile the useful throughput is also insured to be at maximum value. The second chapter considers packet radio performance over fast fading channels. Here, expressions for the throughput and packet delay of nonpersistent carrier sense multiple access (NPCSMA) protocol in fast fading environment are derived. Upper and lower bounds are obtained for a case where the fading phenomena is neither slow or fast. An alternative technique is used to approximately predict the performance for the cases that exist between these bounds. Both Nakagami fading and noncoherent reception are assumed. GRA

**N88-18766#** United Technologies Research Center, East Hartford, Conn.

**RESEARCH AND DEVELOPMENT OF SURFACE SKIMMING BULK WAVE DEVICES FOR SENSOR APPLICATIONS Final Report, 1 Apr. 1985 - 30 Jun. 1987**

Donald E. Cullen Aug. 1987 90 p

(Contract F49620-85-C-0061)

(AD-A187504; UTRC/R87-927145; AFOSR-87-1445TR) Avail: NTIS HC A05/MF A01 CSCL 17G

The application of surface skimming bulk wave (SSBW) technology to sensors, and to an accelerometer in particular, was investigated through further studies of the properties of the SSBW mode, and through the design, fabrication, and evaluation of a laboratory SSBW cantilever beam accelerometer. The long-term stability of the SSBW mode for devices immersed in a damping fluid was shown to be equal to the stability of vacuum sealed devices (approx. 5 ppm/year). The relevant properties of the dual delay line configuration (SSBW devices on both sides of a single substrate) were investigated. The damping of mechanical vibrations in a cantilever quartz beam was studied, establishing the fact that critical damping of the beam can be achieved without difficulty. Evaluation of SSBW accelerometer models showed that the acceleration sensitivity of these devices can be accurately predicted from theory, and that fluid damping can reduce the vibration sensitivity of the SSBW oscillator to less than 5 x 10 to the minus 8th power/G. The results of this study indicate that a practical milli-G range SSBW accelerometer can be developed. GRA

**N88-18767#** Army Construction Engineering Research Lab., Champaign, Ill.

**A DYNAMIC ANALYSIS OF THE PARALLEL-PLATE EMP (ELECTROMAGNETIC PULSE) SIMULATOR USING A WIRE MESH APPROXIMATION AND THE NUMERICAL ELECTROMAGNETICS CODE Final Report**

Stephen D. Gedney Sep. 1987 166 p

(AD-A187535; CERL-TM-M-87/15) Avail: NTIS HC A08/MF A01 CSCL 20O

The Electromagnetic Pulse (EMP) produced by a high-altitude nuclear blast presents a severe threat to electronic systems due to its extreme characteristics. To test the vulnerability of large systems, such as airplanes, missiles, or satellites, they must be subjected to a simulated EMP environment. One type of simulator that has been used to approximate the EMP environment is the Large Parallel-Plate Bounded-Wave Simulator. It is a guided wave simulator which has properties of transmission line and supports a single TEM model at sufficiently low frequencies. This type of simulator consists of finite-width parallel-plate waveguides, which are excited by a wave launcher and terminated by a wave receptor. This study addresses the field distribution within a finite-width parallel-plate waveguide that is matched to a conical tapered waveguide at either end. Characteristics of a parallel-plate bounded-wave EMP simulator were developed using scattering theory, thin-wire mesh approximation of the conducting surfaces, and the Numerical Electronics Code (NEC). Background is provided for readers to use the NEC as a tool in solving thin wire scattering problems. GRA

**N88-18768#** California Univ., Los Angeles. Dept. of Engineering Systems.

**BACKSCATTERING FROM THREE DIMENSIONAL CONDUCTING BODIES Final Report, 1 Aug. 1977 - 30 Sep. 1978**

Cornelius T. Leondes Oct. 1987 75 p

(Contract F33615-77-C-1201)

(AD-A187570; AFWAL-TR-87-1134) Avail: NTIS HC A04/MF A01 CSCL 17I

The report investigates electromagnetic backscattering from three dimensional objects. It uses the following simulation approaches: physical optics together with the physical theory of diffraction; numerical methods; geometrical optics with the geometric theory of diffraction. Physical objects modelled are a sphere and a spherical segment. The report concludes that geometrical optics together with the geometric theory of diffraction is the most practical way of calculating EM backscatter from conducting objects. GRA

**N88-18769#** Naval Postgraduate School, Monterey, Calif.

**AN EVALUATION OF THE IMPACT OF VARIABLE TEMPORAL AND SPATIAL DATA RESOLUTION UPON IREPS (INTEGRATED REFRACTIVE EFFECTS PREDICTION SYSTEM) M.S. Thesis**

Michael E. Dotson Jun. 1987 63 p

(AD-A187764) Avail: NTIS HC A04/MF A01 CSCL 04A

Atmospheric refractive index gradients significantly modify the path of electromagnetic (EM) waves as they propagate through the atmosphere. Accordingly, the performance of U.S. Navy (EM) systems can be either degraded or enhanced due to atmospheric conditions which effect atmospheric refractive index profiles. The Integrated Refractive Effects Prediction System (IREPS) version 2.2 is the latest software developed by Naval Ocean Systems Center (NOSC) to predict atmospheric refraction and its resulting effect on EM systems. Specific environmental parameters are used as input data to produce various output products to be used by the tactician in planning the optimum use of naval assets. The quality and accuracy of the resulting output is directly related to the quality and timeliness of the input data. This thesis study

shows the importance of timely, high resolution data, for input into the IREPS version 2.2 program, in order to obtain realistic atmospheric refractive and corresponding EM system performance predictions. A continentally derived data set is used to compare the results of using high resolution versus low resolution data as input into IREPS, and to qualitatively show how quickly the refractive structure of the atmosphere can vary with time. A second data set from an over ocean experiment attacks the horizontally homogeneous atmosphere assumption which appears to be frequently incorrectly applied. Finally, a statistical comparison can result in significant variations of atmospheric refractivity that could affect Naval EM systems. GRA

**N88-18770#** Communications Research Centre, Ottawa (Ontario).
**THE CHARACTERISTICS OF TWO BROADBAND (2 MHz TO 10 MHz) SWITCHED VEE ANTENNAS**
G. M. Royer Jan. 1987 52 p
(AD-A187874; CRC-1416) Avail: NTIS HC A04/MF A01 CSCL 09A

The characteristics of many antennas were investigated and evaluated against the general specification listed below. This document presents the properties of the two (switched vee) antennas which were judged to be best suited for the application. Specification 1: The antenna is to serve as components for a 2 MHz to 10 MHz communications system where the signal's propagation path includes one reflection from the ionosphere and the separation between the transmitter and receiver is such that the signal's angle of incidence on the ionosphere is 50 deg or less. Specification 2: The antenna's construction is to be such as to make it as easy, as is practical, to change the system's site. GRA

**N88-18771#** Illinois Univ., Urbana. Coordinated Science Lab.
**FIXED AND ADAPTIVE INTERFRAME IMAGE PREDICTION FOR REMOTE PILOTING APPLICATION M.S. Thesis**
Manorama G. Raghavender Oct. 1987 95 p
(Contract N00014-84-C-0149)
(AD-A187987; UILU-END-87-2263) Avail: NTIS HC A05/MF A01 CSCL 25E

Digital image processing has gained considerable importance due to its numerous applications in the aerospace, biomedical, commercial television and video teleconferencing systems. The availability of super-fast chips for digital data processing has made the hardware implementation of the image processing algorithms feasible for satellite applications due to the reduction achieved in weight, size and power consumption. A considerable amount of work done in the area of image processing has focused on coding, bandwidth compression and pattern recognition. In this work, we focus on the estimation of image data using past statistics. We are interested in an on-line prediction of the next few frames of a video sequence using the available frames. The problem is that of parameter identification of a time-varying system using a priori knowledge. We apply estimation theory concepts and derive a fixed predictor as well as one that is adaptive, i.e., one which predicts frames by analyzing the data which was received most recently. GRA

**N88-18772#** University of Southern California, Los Angeles. Optical Materials and Devices Lab.
**INTEGRATED OPTICAL SYNTHETIC APERTURE RADAR PROCESSOR Final Report, 1 Sep. 1984 - 30 Nov. 1985**
Armand R. Tanguay, Jr. Sep. 1987 53 p
(Grant AF-AFOSR-0352-84)
(AD-A188019; USC/OMDL-1601; AFOSR-87-2026TR) Avail: NTIS HC A04/MF A01 CSCL 17I

The principal objective of this research program was initiation of the development of a compact, rugged, low-cost, low-power optical synthetic aperture radar processor for real time image formation aboard airborne and spaceborne platforms. The extremely high computational burden associated with SAR imaging has thus far limited the usefulness of the technique to non-real-time applications from fixed platform bases. Existing realtime digital and optical techniques are in general too bulky, power consumptive, and expensive for broad applicability, particularly in space-confined mobile environments. The integrated optics approach described herein provides a powerful solution with which to circumvent these limitations. GRA

**N88-18773#** North Carolina Univ., Chapel Hill. Dept. of Computer Science.
**FUZZY LOGIC INFERENCE PROCESSOR FOR REAL TIME CONTROL: A SECOND GENERATION FULL CUSTOM DESIGN**
Hiroyuki Watanabe and Wayne Dettloff 1986 7 p
(Contract N00014-86-K-0680)
(AD-A188155) Avail: NTIS HC A02/MF A01 CSCL 25E

The Very Large Scale Integration (VLSI) implementation of a fuzzy logic inference mechanism allows the use of rule-based control and decision making in demanding real-time applications such as robot control and in the area of command and control. The full custom CMOS VLSI is described. The chip is second generation of the design. It has several design features which make the use of this chip realistic. These features include reconfigurable architecture, on-chip fuzzification and de-fuzzification, and memory and data-path redundancy. The chip consists of 614,000 transistors of which 460,000 are used for RAM memory. GRA

**N88-18774*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Oct. - Dec. 1987**
E. C. Posner, ed. 15 Feb. 1988 211 p
(NASA-CR-182545; JPL-TDA-PR-42-92; NAS 1.26:182545) Avail: NTIS HC A10/MF A01 CSCL 17B

The Office of Space Operation (OSO) tasks addressed include: Deep Space Network (DSN) advanced systems and systems implementation. The Office of Space Science and Applications (OSSA) tasks discussed include SETI data controllers and simulated performance for narrowband signal detection. For individual titles, see N88-18775 through N88-18796.

**N88-18775*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SOURCE AND EVENT SELECTION FOR RADIO-PLANETARY FRAME-TIE MEASUREMENTS USING THE PHOBOS LANDERS**
R. Linfield and J. Ulvestad *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 1-12 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 17B

The Soviet Phobos Lander mission will place two spacecraft on the Martian moon Phobos in 1989. Measurements of the range from Earth-based stations to the landers will allow an accurate determination of the ephemerides of Phobos and Mars. Delta Very Long Base Interferometry (VLBI) between the landers and compact radio sources nearby on the sky will be used to obtain precise estimates of the angular offset between the radio and planetary reference frames. The accuracy of this frame-tie estimate is expected to be in the vicinity of 10 mrad, depending on how well several error sources can be controlled (calibrated or reduced). Many candidate radio sources for VLBI measurements were identified, but additional work is necessary to select those sources which have characteristics appropriate to the present application. Strategies for performing the source selection are described. Author

**N88-18776*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE JPL TRAPPED MERCURY ION FREQUENCY STANDARD** **c70**
J. D. Prestage, G. J. Dick, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 13-19 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 20C

In order to provide frequency standards for the Deep Space Network (DSN) which are more stable than present-day hydrogen

masers, a research task was established under the Advanced Systems Program of the TDA to develop a Hg-199(+) trapped ion frequency standard. The first closed-loop operation of this kind is described. Mercury-199 ions are confined in an RF trap and are state-selected through the use of optical pumping with 194 nm UV light from a Hg-202 discharge lamp. Absorption of microwave radiation at the hyperfine frequency (40.5 GHz) is signaled by atomic fluorescence of the UV light. The frequency of a 40.5 GHz oscillator is locked to a 1.6 Hz wide atomic absorption line of the trapped ions. The measured Allan variance of this locked oscillator is currently gamma sub y (pi) = 4.4 x 10 to the minus 12th/square root of pi for 20 is less than pi is less than 320 seconds, which is better stability than the best commercial cesium standards by almost a factor of 2. This initial result was achieved without magnetic shielding and without regulation of ion number. Author

**N88-18777*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**USING RIDGE REGRESSION IN SYSTEMATIC POINTING ERROR CORRECTIONS**

C. N. Guiar *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 20-26 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

A pointing error model is used in the antenna calibration process. Data from spacecraft or radio star observations are used to determine the parameters in the model. However, the regression variables are not truly independent, displaying a condition known as multicollinearity. Ridge regression, a biased estimation technique, is used to combat the multicollinearity problem. Two data sets pertaining to Voyager 1 spacecraft tracking (days 105 and 106 of 1987) were analyzed using both linear least squares and ridge regression methods. The advantages and limitations of employing the technique are presented. The problem is not yet fully resolved. Author

**N88-18778*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**AN OPTIMAL STRUCTURE FOR A 34-METER MILLIMETER-WAVE CENTER-FED BWG ANTENNA: THE CROSS-BOX CONCEPT**

K. L. Chuang *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 27-39 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

An approach to the design of the planned NASA/JPL 34 m elevation-over-azimuth (Az-El) antenna structure at the Venus site (DSS-13) is presented. The antenna structural configuration accommodates a large (2.44 m) beam waveguide (BWG) tube centrally routed through the reflector-alidade structure, an elevation wheel design, and an optimal structural geometry. The design encompasses a cross-box elevation wheel-reflector base substructure that preserves homology while satisfying many constraints, such as structure weight, surface tolerance, stresses, natural frequency, and various functional constraints. The functional requirements are set to ensure that microwave performance at millimeter wavelengths is adequate. The cross-box configuration was modeled, optimized, and found to satisfy all DSN HEF baseline antenna specifications. In addition, the structure design was conceptualized and analyzed with an emphasis on preserving the structure envelope and keeping modifications relative to the HEF antennas to a minimum, thus enabling the transferability of the BWG technology for future retrofitting. Good performance results were obtained. Author

**N88-18779*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A 2.3-GHz MASER AT USUDA, JAPAN, FOR TDRSS-ORBITING VLBI EXPERIMENT** **c36**

R. B. Quinn *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 40-42 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 20E

A 2.3 GHz traveling-wave maser/closed-cycle refrigerator (TWM/CCR) that is used in the DSN was installed and successfully operated on the 64 m antenna at Usuda, Japan. The TWM/CCR supported the first very long baseline interferometry (VLBI) experiment to use an orbiting spacecraft as one of the receiving antennas. The experiment required a 15 K receiving system over a 2271 to 2285 MHz bandwidth. The maser installation was made during June 1986, and successful VLBI measurements were made during July and August 1986 and again in January 1987. Author

**N88-18780*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A LOWER BOUND FOR THE DECODER ERROR PROBABILITY OF THE LINEAR MDS CODE** **c64**

K.-M. Cheung *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 43-49 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 12A

A lower bound for the decoder error probability (P sub E (u)) of a linear maximum distance separable (MDS) code is derived by counting the dominant types of decoding words around code words. It is shown that the lower bound derived is similar in form, and close numerically, to the upper bound derived. Author

**N88-18781*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A LABELING PROCEDURE FOR LINEAR FINITE-STATE CODES** **c61**

K.-M. Cheung *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 50-55 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 09B

A method to define the labels of the state diagram of a linear finite-state code is presented and investigated. This method is particularly suitable for simple hardware implementation since it simplifies the encoder structure. The method can also be applied to the labeling of a state diagram that is not completely connected to obtain a linear finite state code with larger free distance. Author

**N88-18782*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**FURTHER RESULTS ON FINITE-STATE CODES** **c61**

F. Pollara, K.-M. Cheung, and R. J. McEliece (California Inst. of Tech., Pasadena.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 56-62 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 09B

A general construction for finite-state (FS) codes is applied to some well-known block codes. Subcodes of the (24,12) Golay code are used to generate two optimal FS codes with d sub free = 12 and 16. A partition of the (16,8) Nordstrom-Robinson code yields a d sub free = 10 FS code. Simulation results are shown and decoding algorithms are briefly discussed. Author

**N88-18783*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A COMPARISON OF VLSI ARCHITECTURES FOR TIME AND TRANSFORM DOMAIN DECODING OF REED-SOLOMON CODES** **c67**

I. S. Hsu, T. K. Truong, L. J. Deutsch, E. H. Satorius, and I. S. Reed (University of Southern California, Los Angeles.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 63-81 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 12E

It is well known that the Euclidean algorithm or its equivalent, continued fractions, can be used to find the error locator polynomial needed to decode a Reed-Solomon (RS) code. It is shown that this algorithm can be used for both time and transform domain decoding by replacing its initial conditions with the Forney syndromes and the erasure locator polynomial. By this means

both the errata locator polynomial and the errate evaluator polynomial can be obtained with the Euclidean algorithm. With these ideas, both time and transform domain Reed-Solomon decoders for correcting errors and erasures are simplified and compared. As a consequence, the architectures of Reed-Solomon decoders for correcting both errors and erasures can be made more modular, regular, simple, and naturally suitable for VLSI implementation. Author

**N88-18784*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SPACECRAFT TELECOMMUNICATIONS SYSTEM MASS ESTIMATES**

J. H. Yuen and L. L. Sakamoto *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 82-88 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

Mass is the most important limiting parameter for present-day planetary spacecraft design. In fact, the entire design can be characterized by mass. The more efficient the design of the spacecraft, the less mass will be required. The communications system is an essential and integral part of planetary spacecraft. A study is presented of the mass attributable to the communications system for spacecraft designs used in recent missions in an attempt to help guide future design considerations and research and development efforts. The basic approach is to examine the spacecraft by subsystem and allocate a portion of each subsystem to telecommunications. Conceptually, this is to divide the spacecraft into two parts, telecommunications and nontelecommunications. In this way, it is clear what the mass attributable to the communications system is. The percentage of mass is calculated using the actual masses of the spacecraft parts, except in the case of CRAF. In that case, estimated masses are used since the spacecraft was not yet built. The results show that the portion of the spacecraft attributable to telecommunications is substantial. The mass fraction for Voyager, Galileo, and CRAF (Mariner Mark 2) is 34, 19, and 18 percent, respectively. The large reduction of telecommunications mass from Voyager to Galileo is mainly due to the use of a deployable antenna instead of the solid antenna on Voyager. Author

**N88-18785*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**PHASE CALIBRATION GENERATOR** c35

E. H. Sigman *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 89-104 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 14B

A phase calibration system was developed for the Deep Space Stations to generate reference microwave comb tones which are mixed in with signals received by the antenna. These reference tones are used to remove drifts of the station's receiving system from the detected data. This phase calibration system includes a cable stabilizer which transfers a 20 MHz reference signal from the control room to the antenna cone. The cable stabilizer compensates for delay changes in the long cable which connects its control room subassembly to its antenna cone subassembly in such a way that the 20 MHz is transferred to the cone with no significant degradation of the hydrogen maser atomic clock stability. The 20 MHz reference is used by the comb generator and is also available for use as a reference for receiver LO's in the cone. Author

**N88-18786*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A SIMPLIFIED, GENERAL-PURPOSE DEEP-SPACE RANGING CORRELATOR DESIGN**

R. C. Tausworthe and J. R. Smith *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 105-109 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

A much-simplified, yet more general-purpose multi-channel deep-space ranging system correlator design that was used in past JPL spacecraft ranging systems is described. The method applies to detection of both single-component and multiple-component ranging codes, in either sequential (mu) or composite (pi) transmitted forms, and using either pseudonoise or square-wave components. Using this design, the Phobos Probe ranging system correlator computational complexity was reduced by over three orders of magnitude in multiply-and-add circuits and 45,000 bits of accumulator storage. Author

**N88-18787*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**FRAME SYNCHRONIZATION PERFORMANCE AND ANALYSIS** c17

C. S. R. Aguilera, L. Swanson, and G. H. Pitt, III *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 110-116 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 09F

The analysis used to generate the theoretical models showing the performance of the frame synchronizer is described for various frame lengths and marker lengths at various signal to noise ratios and bit error tolerances. Author

**N88-18788*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A NOISE-ADDING RADIOMETER FOR THE PARKES ANTENNA** c17

T. J. Brunzie *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 117-122 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 09F

A design for a noise-adding radiometer will be included as part of the reimplementation of the Parkes antenna microwave front end. Designed as an aid for antenna calibration, the Parkes NAR will support the Voyager-Neptune encounter in 1989. Author

**N88-18789*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**X-BAND SYSTEM PERFORMANCE OF THE VERY LARGE ARRAY**

J. S. Ulvestad, G. M. Resch, and W. D. Brundage (National Radio Astronomy Observatory, Socorro, N. Mex.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 123-137 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

The Very Large Array (VLA) is being equipped to receive telemetry from Voyager 2 during the Neptune encounter in 1989. Cryogenically cooled amplifiers are being installed on each of the 27 antennas. These amplifiers are currently a mix of field effect transistors (FETs) and high electron mobility transistors (HEMTs) and exhibit zenith system temperatures that range from 30 to 52 K. The system temperatures and aperture efficiencies determined during the past year are summarized. The nominal values of the noise diode calibration are compared with derived values made under the assumption of a uniform atmosphere over the array. Gain values are determined from observations of unresolved radio sources whose flux densities are well known. The tests suggest that the completed VLA will have a ratio of gain to system temperature that is approximately 4.4 dB above that of a single 64 m antenna of the Deep Space Network. Author

**N88-18790*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**DSS 14 64-METER ANTENNA S- AND X-BAND EFFICIENCY AND SYSTEM NOISE TEMPERATURE CALIBRATIONS, SEPTEMBER 1987**

S. D. Slobin *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 138-146 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 17B

The efficiency and noise temperature characteristics of the DSN 64 m antenna network prior to its upgrading to 70 m configuration are documented. The DSS 14 (Goldstone, California) is the last

of the three large antennas to be upgraded, and the test results presented document its performance just prior to its downtime during the end of 1987. Antenna area efficiency was found to be somewhat higher at DSS 14 than at DSS 43 (Australia) and DSS 63 (Spain). The peak X-band efficiency was determined to be 49.8 percent (without atmosphere), compared with 45.4 and 45.1 percent for DSS 43 and DSS 63, respectively. The X-band zenith system noise temperature was found to be 1 to 3 Kelvins higher than at the other two stations, depending on which maser was chosen for the measurements. Ascribing efficiency differences to small-scale antenna surface roughness, DSS 14 may be regarded as having a 1.5 to 1.6 mm rms surface as compared to the other two antennas with 1.7 to 1.8 mm rms surfaces. Author

**N88-18791*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**NEW MODE SWITCHING ALGORITHM FOR THE JPL 70-METER ANTENNA SERVO CONTROLLER c33**
J. A. Nickerson *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 147-153 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09A

The design of control mode switching algorithms and logic for JPL's 70 m antenna servo controller are described. The old control mode switching logic was reviewed and perturbation problems were identified. Design approaches for mode switching are presented and the final design is described. Simulations used to compare old and new mode switching algorithms and logic show that the new mode switching techniques will significantly reduce perturbation problems. Author

**N88-18792*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**OPTICAL LINKS IN THE ANGLE-DATA ASSEMBLY OF THE 70-METER ANTENNAS c74**
M. D. Nelson, J. R. Schroeder, and E. F. Tubbs *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 154-165 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 20F

In the precision-pointing mode the 70 meter antennas utilize an optical link provided by an autocollimator. In an effort to improve reliability and performance, commercial instruments were evaluated as replacement candidates, and upgraded versions of the existing instruments were designed and tested. The latter were selected for the Neptune encounter, but commercial instruments with digital output show promise of significant performance improvement for the post-encounter period. Author

**N88-18793*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SEVENTY-METER ANTENNA PERFORMANCE PREDICTIONS: GTD ANALYSIS COMPARED WITH TRADITIONAL RAY-TRACING METHODS**
J. M. Schredder (Planning Research Corp., McLean, Va.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 166-174 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 17B

A comparative analysis was performed, using both the Geometrical Theory of Diffraction (GTD) and traditional pathlength error analysis techniques, for predicting RF antenna gain performance and pointing corrections. The NASA/JPL 70 meter antenna with its shaped surface was analyzed for gravity loading over the range of elevation angles. Also analyzed were the effects of lateral and axial displacements of the subreflector. Significant differences were noted between the predictions of the two methods, in the effect of subreflector displacements, and in the optimal subreflector positions to focus a gravity-deformed main reflector. The results are of relevance to future design procedure. Author

**N88-18794*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE DESIGN AND IMPLEMENTATION OF THE TECHNICAL FACILITIES CONTROLLER (TFC) FOR THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX c66**
D. A. Killian, F. J. Menninger, T. Gorman, and P. Glenn *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 175-183 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 12B

The Technical Facilities Controller is a microprocessor-based energy management system that is to be implemented in the Deep Space Network facilities. This system is used in conjunction with facilities equipment at each of the complexes in the operation and maintenance of air-conditioning equipment, power generation equipment, power distribution equipment, and other primary facilities equipment. The implementation of the Technical Facilities Controller was completed at the Goldstone Deep Space Communications Complex and is now operational. The installation completed at the Goldstone Complex is described and the utilization of the Technical Facilities Controller is evaluated. The findings will be used in the decision to implement a similar system at the overseas complexes at Canberra, Australia, and Madrid, Spain. Author

**N88-18795*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SETI DATA CONTROLLERS c33**
R. M. Gosline *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 184-190 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09A

Three data controllers developed for the SETI project are described. Two are used primarily for recording and playback of SETI data from the Radio Science Surveillance System (RSSS). The third is used as a SETI station controller for DSS 13. Author

**N88-18796*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SIMULATED PERFORMANCE OF AN ORDER STATISTIC THRESHOLD STRATEGY FOR DETECTION OF NARROWBAND SIGNALS**
E. Satorius, R. Brady, W. Deich, S. Gulkis, and E. Olsen *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 191-197 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 17B

The application of order statistics to signal detection is becoming an increasingly active area of research. This is due to the inherent robustness of rank estimators in the presence of large outliers that would significantly degrade more conventional mean-level-based detection systems. A detection strategy is presented in which the threshold estimate is obtained using order statistics. The performance of this algorithm in the presence of simulated interference and broadband noise is evaluated. In this way, the robustness of the proposed strategy in the presence of the interference can be fully assessed as a function of the interference, noise, and detector parameters. Author

**N88-18797#** California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.
**ANALYTICAL AND NUMERICAL ANALYSIS OF FINITE AMPLITUDE RAYLEIGH-TAYLOR INSTABILITY**
D. I. Meiron and P. G. Saffman 18 Sep. 1987 39 p
(Contract W-7405-eng-48)
(DE88-004056; UCRL-15983) Avail: NTIS HC A03/MF A01

A simple model of bubble competition in Rayleigh-Taylor unstable flows is described which gives results which are in good agreement with experiment. In addition the model has been compared with two dimensional numerical simulations of inviscid Rayleigh-Taylor instability using the cloud-in-cell method. These simulations can now be run into the late time regime and can

track the competition of as many as ten bubbles. The improvement in performance over previous applications of the cloud-in-cell approach is due to the application of finite difference techniques designed to handle shock-like structures in the vorticity of the interface which occur at late times. We propose to extend the research carried thus far to Rayleigh-Taylor problems in three dimensional and convergent geometries as well as to two-fluid instabilities in which interface roll-up is observed. DOE

**N88-18798#** Lawrence Livermore National Lab., Calif.
**NUMERICAL SIMULATION OF THE PROPAGATION AND ABSORPTION DUE TO AIR BREAKDOWN OF LONG MICROWAVE PULSES**
G. E. Sieger, D. J. Mayhall, and J. H. Yee Oct. 1987 12 p Presented at the 8th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, Calif., 27 Oct. 1987
(Contract W-7405-eng-48)
(DE88-005227; UCRL-96552; CONF-871093-3) Avail: NTIS HC A03/MF A01

In order to calculate the propagation of long microwave pulses in air, we have developed a steady-state fluid code, in which the electric field is a time-harmonic wave whose amplitude and frequency are allowed to vary slowly in time. The method of calculation makes use of the assumption that at each position and time the electron fluid is equilibrated at the local field amplitude and frequency. DOE

**N88-18799** Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
**THE MAXIMUM ENTROPY METHOD FOR THE ANALYSIS OF RADAR ECHOES FROM HOVERING HELICOPTERS IN CLUTTER**
H. Schneider Mar. 1987 39 p In GERMAN; ENGLISH summary
(Contract BMVg-T/RF31/E0020/E1317)
(FB-2-87; Lfd-259; ETN-88-91026) Copyright Avail: Issuing Activity

The maximum entropy (ME) method for the spectral analysis of helicopter radar echoes is discussed on the basis of simulation studies and real measured data. Reflection signals in the VHF and S-bands were analyzed. For radar reflection times that are long in comparison with the rotor blade period, good agreement is found with the discrete Fourier transform method. For radar reflection times of the order of the rotor blade period, the ME-method does not have a better spectral resolution than the discrete Fourier transform method. The ME-method can only provide an improved frequency resolution limit if the radar echo scanning frequency is substantially higher than the bandwidth of the helicopter rotor lines. The application of Cepstrum analysis for the identification of rotor blade frequencies is discussed. ESA

**N88-18800#** Goettingen Univ. (West Germany). Mathematisch-Naturwissenschaftlichen Fachbereiche.
**INTEGRAL EQUATIONS WITH MODIFIED FUNDAMENTAL SOLUTIONS FOR EXTERIOR BOUNDARY VALUE PROBLEMS FROM ELECTROMAGNETIC WAVE THEORY Ph.D. Thesis [INTEGRALGLEICHUNGEN MIT MODIFIZIERTER GRUNDLOESUNG FUER AUSSENRAUMRANDWERTPROBLEME AUS DER THEORIE ELEKTROMAGNETISCHER WELLEN]**
Gabrielle Jost 1986 111 p In GERMAN
(ETN-88-91483) Avail: NTIS HC A06/MF A01

The application of the method of the modified fundamental solution of integral equations to exterior boundary value problems from the theory of electromagnetic waves was investigated. The modification of the fundamental solution for the scalar Helmholtz equation is presented. It is shown that this solution can be considered as a dyadic. The existence proofs for three electromagnetic boundary value problems are given. It is demonstrated that the addition of a suitable finite series for the fundamental solution is sufficient to obtain uniqueness. ESA

**N88-18801** Maryland Univ., College Park.
**MICROWAVE RADIATION FROM ROTATING, ANNULAR ELECTRON BEAMS Ph.D. Thesis**
Eric Paul Chojnacki 1987 134 p
Avail: Univ. Microfilms Order No. DA8725480

The generation of microwave radiation at high harmonics of the electron cyclotron frequency was studied in both large orbit gyrotron and circulating Free Electron Laser (FEL) configurations. In the large orbit gyrotron experiments, a low energy annular rotating electron beam interacts with the modes of a surrounding magnetron-type waveguide to produce microwave radiation. The axis encircling E layer is produced by passing a linearly streaming hollow beam through a magnetic cusp. Narrowband microwave radiation was obtained from the device at various power levels in various modes of operation; the dominant mode being an eighth cyclotron harmonic synchronous resonance having a power level of 9.1 kW at 6.78 GHz, corresponding to an efficiency of tens of percent. A synchronous resonance at the tenth cyclotron harmonic was also excited as well as a cyclotron mode resonance at the eight harmonic. Measurements of the radiated power spectra and confining magnetic field allowed identification of operating waveguide modes and instability mechanisms. In the circulating FEL studies, a linear growth rate analysis reveals that fast and slow spacecharge waves slightly alter the ponderomotive beam wave resonance condition. The existence of fast and slow spacecharge wave interaction is supported by experimental results from a low energy device consisting of ten azimuthal wiggler periods in hollow waveguide configurations. Dissert. Abstr.

**N88-18802** Dayton Univ., Ohio.
**THE APPLICATION OF THE HYBRID ITERATIVE METHOD TO SCATTERING BY PERFECTLY CONDUCTING BODIES OF REVOLUTION Ph.D. Thesis**
Ghassan Hatem Falouh 1987 212 p
Avail: Univ. Microfilms Order No. DA8724506

The problem of electromagnetic scattering from bodies of revolution with illumination being along the axis of symmetry is studied. The Hybrid Iterative Method (HIM) is applied to solve the Magnetic Field Integral Equation (MFIE) for the surface current density and subsequently to determine the scattering cross sections in the E- and H-planes. Some of the results for both the sphere and the prolate spheroid of different sizes are presented. The surface current distribution on the sphere as a scatterer and the bistatic cross section in E and H planes are compared with the exact solution. Excellent agreement is obtained in all cases substantiating the HIM as an effective and applicable method to solve three dimensional scattering problems. Dissert. Abstr.

**N88-18803** Colorado Univ., Boulder.
**THE COAXIAL COLINEAR ANTENNA: THEORETICAL AND EXPERIMENTAL MODELS Ph.D. Thesis**
Thierry Jean Judasz 1987 229 p
Avail: Univ. Microfilms Order No. DA8723471

A theoretical model and computer simulations of the current distribution on the coaxial colinear (COCO) antenna are presented. The model takes a simple form when the elements of the COCO antenna are (lambda c)/2 long and lossless. Lambda c is the wavelength in the coaxial cable. Comparisons between numerical results and measurements are made for center-fed and end-fed COCO antennas at 50 MHz and 915 MHz. Theory and measurements agree well. COCO antennas made of coaxial cable containing two dielectrics are investigated. Tapered current distributions are obtained on COCO antennas containing lossy dielectric. Currents, voltages, impedances, and power flow are computed at the connections of, and inside, a typical COCO antenna. The linear systems of equations of the theoretical model are solved using a preconditioned complex conjugate gradient method. This method saves significant amounts of computer time compared to other methods. Also discussed are the coupling between COCO antennas placed end to end, the bandwidth of a COCO antenna, tilted beams, the effect of temperature on the inner dielectric of the coaxial cables, dielectric coated antennas, and the effects of imperfectly conducting ground on the current

distributions and on the E-field patterns of COCO antennas.
Dissert. Abstr.

**N88-18804** Pennsylvania Univ., Philadelphia.
**AUTOMATED RADAR TARGET RECOGNITION BASED ON MODELS OF NEURAL NETS Ph.D. Thesis**
Shunji Miyahara 1987 198 p
Avail: Univ. Microfilms Order No. DA8725190

Two methods of target recognition are proposed: (1) the use of sinogram representations as learning set in associative memory, based on models of neural nets as classifier; and (2) use of polarization representation for use in neural net based associative memory as a classifier. Using microwave scattering data of scaled model targets, the concepts for the target recognition were demonstrated by computer simulation of a 1024 (32 by 32) element neural net associative memory based on the outer product model. The simulations show that partial input, consisting of less than 10 percent of the total information, can identify the targets. Two-dimensional optical implementations of a neural net of 8 by 8 binary neurons were studied. Fault tolerance and robustness were examined, using a four-dimensional clipped outer product ternary Tijkl mask to establish the weighted interconnections of the net and electronic feedback based on closed loop TV systems. The performance was found to be in agreement with that of computer simulation, even though aberration of lenses and the defects of the system were present. These results confirm the practical suitability of the opto-electronic approach to the neural net implementation and pave the way for the implementation of larger networks.
Dissert. Abstr.

**N88-18805*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**COMPENSATION OF RELECTOR ANTENNA SURFACE DISTORTION USING AN ARRAY FEED**
A. R. Cherrette, R. J. Acosta, P. T. Lam, and S. W. Lee (Illinois Univ., Urbana.) Jan. 1988 49 p
(Grant NAG3-419)
(NASA-TM-100286; E-3929; NAS 1.15:100286) Avail: NTIS HC A03/MF A01 CSCL 20N

The dimensional stability of the surface of a large reflector antenna is important when high gain or low sidelobe performance is desired. If the surface is distorted due to thermal or structural reasons, antenna performance can be improved through the use of an array feed. The design of the array feed and its relation to the surface distortion are examined. The sensitivity of antenna performance to changing surface parameters for fixed feed array geometries is also studied. This allows determination of the limits of usefulness for feed array compensation.
Author

**N88-18806*#** Ohio State Univ., Columbus. ElectroScience Lab.
**A NEW APPROACH FOR SHAPING OF DUAL-REFLECTOR ANTENNAS**
Teh-Hong Lee, W. D. Burnside, and Roger C. Rudduck Dec. 1987 228 p
(Grant NsG1-613)
(NASA-CR-182581; NAS 1.26:182581; OSU-ESL-TR-716148-26)
Avail: NTIS HC A11/MF A01 CSCL 20N

The shaping of 2-D dual-reflector antenna systems to generate a prescribed distribution with uniform phase at the aperture of the second reflector is examined. This method is based on the geometrical nature of Cassegrain and Gregorian dual-reflector antennas. The method of syntheses satisfies the principles of geometrical optics which are the foundations of dual-reflector designs. Instead of setting up differential equations or heuristically designing the subreflector, a set of algebraic equations is formulated and solved numerically to obtain the desired surfaces. The caustics of the reflected rays from the subreflector can be obtained and examined. Several examples of 2-D dual-reflector shaping are shown to validate the study. Geometrical optics and physical optics are used to calculate the scattered fields from the reflectors.
Author

**N88-18807*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**ADAPTIVE CONTROL OF A MANIPULATOR WITH A FLEXIBLE LINK Final Report**
Y. P. Yang and J. S. Gibson (California Univ., Los Angeles.) Feb. 1988 20 p Submitted for publication
(Contract NAS1-18107; Grants AF-AFOSR-0309-84; AF-AFOSR-0373-87)
(NASA-CR-181637; ICASE-88-17; NAS 1.26:181637) Avail: NTIS HC A03/MF A01 CSCL 13I

An adaptive controller for a manipulator with one rigid link and one flexible link is presented. The performance and robustness of the controller are demonstrated by numerical simulation results. In the simulations, the manipulator moves in a gravitational field and a finite element model represents the flexible link.
Author

**N88-18808#** Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Systems Technology Div.
**A METHODOLOGY TO ASSESS THE EFFECTS OF HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) ON ELECTRIC POWER SYSTEMS**
E. R. Taylor, Jr., C. H. Eichler, and P. R. Barnes 1988 12 p Presented at the IEEE Winter Power Meeting, New York City, N.Y., 2 Feb. 1988 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-000338; CONF-880219-1) Avail: NTIS HC A03/MF A01

Nuclear electromagnetic pulse (EMP) from high altitude nuclear detonations (HEMP) has the potential to seriously disrupt electric power systems. A methodology has been developed to assess the vulnerability of electric power systems to this phenomena for any specified nuclear burst scenario. The methodology is based on a structured approach whereby the power system is broken down into subsystems, functional groups, and circuits and devices. Vulnerability (likelihood of failure) is assessed for individual equipment (circuits and devices) for each nuclear burst scenario. These effects are then evaluated for their performance impact on successively higher system levels. This forms the input for classical load flow, short circuit and transient stability studies to evaluate system stability and survivability. Applicability of the assessment methodology is not dependent on the quality of component/equipment vulnerability data. Susceptibility of power equipment to HEMP damage may be determined by established technical analysis, by interpretation of equipment design and testing standards, and by laboratory testing. This paper has been written not only for the electric utility engineer, but also for experts in EMP who may not be knowledgeable in electric utility systems.
DOE

**N88-18809*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OPTICALLY CONTROLLED PHASED-ARRAY ANTENNA TECHNOLOGY FOR SPACE COMMUNICATION SYSTEMS**
Richard R. Kunath and Kul B. Bhasin 1988 7 p Presented at Optoelectronics and Laser Applications in Science and Engineering (O-E/LASE '88), Los Angeles, Calif., 10-15 Jan. 1988; sponsored by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-100852; E-4055; NAS 1.15:100852) Avail: NTIS HC A02/MF A01 CSCL 17B

Using MMICs in phased-array applications above 20 GHz requires complex RF and control signal distribution systems. Conventional waveguide, coaxial cable, and microstrip methods are undesirable due to their high weight, high loss, limited mechanical flexibility and large volume. An attractive alternative to these transmission media, for RF and control signal distribution in MMIC phased-array antennas, is optical fiber. Presented are potential system architectures and their associated characteristics. The status of high frequency opto-electronic components needed to realize the potential system architectures is also discussed. It is concluded that an optical fiber network will reduce weight and complexity, and increase reliability and performance, but may require higher power.
Author

**N88-18757#** Joint Publications Research Service, Arlington, Va.
**IMPROVED BACKFIRE ANTENNA USING CIRCULAR DIPOLE**
Ximing Song, Ruihua Li, Yufeng Zhang, and Boliang Rao *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 10-13 Transl. into ENGLISH from Dianzi Kexue Xuekan (Journal of Electronics) (Beijing, China), v. 9, no. 1, Jan. 1987 p 82-84 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

**N88-18810#** Massachusetts Inst. of Tech., Cambridge.
**NONLINEAR DYNAMIC MAXIMUM POWER THEOREM**
John L. Wyatt, Jr. Mar. 1987 21 p
(Contract N00014-80-C-0622; Grant NSF ECS-83-10941)
(AD-A187491) Avail: NTIS HC A03/MF A01 CSCL 09A

This paper considers the problem of maximizing the energy or average power transfer from a nonlinear dynamic source. The main theorem includes as special cases the standard linear result Y load = Y source and a recent finding for nonlinear resistive networks. An operator equation for the optimal output voltage is derived, and a numerical method for solving it is given. GRA

**N88-18811#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**RELIC: A RELIABILITY SIMULATOR FOR INTEGRATED CIRCUITS**
Teresa S. Hohol and Lance A. Glasser Jan. 1987 8 p
(Contract N00014-80-C-0622)
(AD-A187493) Avail: NTIS HC A02/MF A01 CSCL 09A

Many of the failure mechanisms which cause reliability problems in very large scale integration (VLSI) chips can be influenced or avoided in the circuit design phase. RELIC is a reliability simulator developed to analyze and predict the stress and wear on metal oxide semiconductor (MOS) VLSI chips due to such mechanisms. RELIC uses a simple methodology for abstracting the idea of the stress from any particular failure mechanism, thus allowing analyses of many different failure mechanisms. There are currently three failure mechanisms analyzed by RELIC: metal migration, hot-electron trapping, and time-dependent dielectric breakdown (TDDB). GRA

**N88-18812#** Air Force Weapons Lab., Kirtland AFB, N. Mex.
**AIR GAP TESTING USING TRAILING WIRE ANTENNA (TWA) WAVEFORM Final Report, 1 May 1985 - 1 Sep. 1986**
R. W. Nethers, D. W. Metzger, and A. B. Griffin Aug. 1987 13 p
(AD-A187639; AFWL-TN-86-49) Avail: NTIS HC A03/MF A01 CSCL 09A

Results of tests of various electrode geometries subjected to high voltage electrical discharge are reported along with test conduct. Three geometries (point-plane, rod-plane, and rod-rod) were tested with both positive and negative voltages. The effect of a uniform field on breakdown voltage was also investigated. The data obtained were compared to the standard lightning breakdown data. The data corresponded well (i.e., within 10 percent) with all other data for negative voltages. Thus, the AWRE voltage holdoff formula is a reasonable method for determining negative voltage breakdown. GRA

**N88-18813#** Naval Research Lab., Washington, D.C.
**HIGH-CURRENT DENSITY, HIGH-BRIGHTNESS ELECTRON BEAMS FROM LARGE-AREA LANTHANUM HEXABORIDE CATHODES Memorandum Report**
P. Loschialpo and C. A. Kapetanakos 13 Dec. 1987 33 p
(AD-A187700; NRL-MR-6119) Avail: NTIS HC A03/MF A01 CSCL 09A

Large (approx. 5 cm) diameter lanthanum hexaboride (LaB6) cathodes operated at 10 kV have produced 1 to 5 micro electron pulses with current density between 10 and 20 A/sq cm. Normalized beam brightness, has been consistently measured. To obtain this high current density, the LaB6 cathodes have been heated to temperatures between approximately 1600 to 1800 C. Very uniform temperature profiles are obtained by applying a carefully tailored electron bombardment heating power distribution. These measurements have been made between pressure .000001 to .00001 Torr, i.e., under much less demanding vacuum conditions than that required by conventional dispenser type cathodes. GRA

**N88-18814#** Naval Postgraduate School, Monterey, Calif.
**DESCRIPTION, ANALYSIS AND SIMULATION OF A NEW REALIZATION OF DIGITAL FILTERS Ph.D. Thesis**
Ahmed F. Mahrous Sep. 1987 185 p
(AD-A187763) Avail: NTIS HC A09/MF A01 CSCL 12E

This research considers a new realization of digital filters suitable for VLSI implementation. The method involves delta modulation which provides analog-to-digital (binary) conversion. The output of a linear system is the convolution of the input and the system impulse response. This new digital filter requires that both the input and the impulse response be first converted to bit streams using delta modulation. These bit streams are then convolved. The result is an analog voltage which approximates the convolution of the analog functions. Direct convolution of the bit streams is difficult to realize with electrical circuits. A greatly simplified system with equivalent performance is a result of this research. This is called the reduced delta convolution (RDC) system (digital filter). The performance of the RDC system when used as a convolver and as a correlator is analyzed and verified by computer simulation. Analyses of the effects of self noise and external noise are included. Conclusions are that the RDC system has considerable potential as a digital filter when using integrated circuits. Realization requires considerably fewer components and simpler connections than other digital filters. A reason is that there are no multipliers required in the RDC system. The RDC system requires no synchronization, operates in real time and is easily programmed. Further, the RDC system has noise performance which is better than predicted by ordinary filter theory. GRA

**N88-18815#** Naval Postgraduate School, Monterey, Calif.
**FREQUENCY-SAMPLING DESIGN OF TWO-DIMENSIONAL FIR DIGITAL FILTERS WITH NONUNIFORM SAMPLES M.S. Thesis**
William J. Rozwod Sep. 1987 82 p
(AD-A187773) Avail: NTIS HC A05/MF A01 CSCL 12A

Various approaches to the frequency-sampling design of two-dimensional FIR filters are analyzed. The IDFT approach requiring uniform sampling on a Cartesian grid is first described. A method which allows arbitrary placement of frequency samples but which does not satisfy the Haar condition is presented. Finally, a novel, computationally efficient method which allows nonuniform sampling and which always provides a unique design solution is presented. The new approach is compared with the other methods in terms of design flexibility, computational efficiency, and performance. GRA

**N88-18816#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**A COMPARATIVE STUDY OF VARIOUS ELECTRIC PROPULSION SYSTEMS AND THEIR IMPACT ON A NOMINAL SHIP DESIGN M.S. Thesis**
James C. Davis Jun. 1987 207 p
(Contract N00228-85-G-3262)
(AD-A187800) Avail: NTIS HC A10/MF A01 CSCL 13J

Computer programs which model synchronous, permanent magnet, and induction machines incorporate an optimization algorithm which converges on lowest weight, volume, and inefficiency. Machine designs for high and low rmps are performed, with a varying number of pole-pairs. The machine designs are

analyzed to find the optimum combination of generator and motor for inclusion in a naval ship propulsion system. The three ships used for the study are: a baseline mechanical transmission ship, a ship retaining the same sub-division as the baseline but with the electric machinery, and an electric transmission ship with subdivision and machinery box arrangement chosen to benefit from the inherent arrangeability of electric transmission. The two generator/motor combinations used in the final ship analysis, both employ a 3600 rpm, six-pole synchronous generator, which turns at the shaft speed of the prime mover. One combination uses a 180 rpm, direct-drive, 16-pole synchronous motor, and the other an 1800 rpm, geared, 8-pole synchronous motor. Power converters are used in both combinations to control motor speed. The geared combination in the rearranged ship demonstrated the best endurance speed efficiency, reducing the endurance fuel load by 18 percent, while maintaining the maximum and sustained speed of the baseline ship. The savings in ship volume translated to an additional twenty Tomahawk missile cells in the rearranged ship. When the fuel load was held at the tonnage of the baseline ship, endurance range increased as much as 25 percent. GRA

**N88-18817#** California Univ., Berkeley. Dept. of Physics.
**QUANTUM LIMITS OF SUPERCONDUCTING HETERODYNE RECEIVERS Annual Technical Report, 15 May 1986 - 14 May 1987**
Paul L. Richards 7 Oct. 1987 5 p
(Grant AF-AFOSR-0230-85)
(AD-A188014; AFOSR-87-1692TR) Avail: NTIS HC A02/MF A01 CSCL 09A

The goal of this research is to produce quantum limited SIS quasiparticle heterodyne receivers at submillimeter wavelengths. The approach is to compare the performance of waveguide and planar lithographed quasi-optical SIS mixers in W-band (lambda approx. 3mm) in order to understand the factors which upgrade the performance of the latter. This information will be used to optimize the planar quasi-optical mixers. Finally, these optimized designs will be scaled to submillimeter wavelengths. Systematic tests of both types of mixers have been carried out during the second grant year. Improved designs of planar quasi-optical mixers have been designed and fabricated. The construction of test apparatus for submillimeter wavelengths has begun. GRA

**N88-18818#** California Univ., Berkeley. Electronics Research Lab.
**THE PIERCE DIODE WITH AN EXTERNAL CIRCUIT. 2: NON-UNIFORM EQUILIBRIA**
William S. Lawson 22 Jul. 1987 46 p
(Contract N00014-85-K-0809)
(AD-A188027; UCB/ERL-M87/52-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 09A

The non-uniform (non-linear) equilibria of the classical (short circuit) Pierce diode and the extended (series RLC external circuit) Pierce diode are described theoretically, and explored via computer simulation. It is found that most equilibria are correctly predicted by theory, but that the continuous set of equilibria of the classical Pierce diode at alpha = 2 pi are not observed. The stability characteristics of the non-uniform equilibria are also worked out, and are consistent with the simulations. GRA

**N88-18819#** Naval Research Lab., Washington, D.C.
**HIGH PEAK POWER Ka-BAND GYROTRON OSCILLATOR EXPERIMENTS WITH SLOTTED AND UNSLOTTED CAVITIES Interim Report, 1 Aug. 1986 - 1 Aug. 1987**
S. H. Gold, A. W. Fliflet, W. M. Manheimer, R. B. McCowan, and R. C. Lee 10 Nov. 1987 39 p
(AD-A188109; NRL-MR-6063) Avail: NTIS HC A03/MF A01 CSCL 09A

A Ka-band gyrotron oscillator powered by a compact pulseline accelerator has been operated using oscillator cavities with and without axial slots. The use of axial slots has been shown to suppress low starting current whispering-gallery modes, in particular modes of the TE(m2) type, allowing stable operation in a linearly-polarized TE(13) mode. A peak power of 35 MW has been observed at 6 percent efficiency. GRA

**N88-18820#** California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.
**DEVELOPMENT OF A PLANAR HETEROJUNCTION BIPOLAR TRANSISTOR FOR VERY HIGH SPEED LOGIC Final Report, 1 Oct. 1984 - 30 Jun. 1987**
Stephen I. Long, Herbert Kroemer, and M. A. Rao 10 Oct. 1987 116 p
(Grant AF-AFOSR-0344-82)
(AD-A188137; AFOSR-87-1655TR) Avail: NTIS HC A06/MF A01 CSCL 09A

The following describes the results of research on 3 to 5 molecular beam epitaxial (MBE) growth, material characterization and the fabrication of heterostructure bipolar transistors (HBT) for very-high-speed logic applications. Work on the InGaP/GaAs heterojunction (HJ) was completed. Isotype HJs were grown and evaluated by a CV reconstruction method in order to determine the energy band offsets. It was found that delta Ec = 0.22 eV and delta Ev = 0.24 eV for the lattice matched composition. An inverted AlGaAs GaAs HBT was investigated, and it was shown that an undoped, graded region between emitter and base would eliminate the conduction band spike and provide a buffer for Be diffusion. A new direction toward improvement in performance and fabrication techniques for the AlGaAs/GaAs HBT was successfully demonstrated. Graded-bandgap nonalloyed ohmic contacts using n+ InAs for the AlGaAs emitter and p+ GaSb for the GaAs base were provided by selective epitaxial regrowth. The MBE growth conditions for grading from GaAs to InAs and GaAs to GaSb were determined. Low specific contact resistances were observed for both contact types. A self-aligned AlGaAs/GaAs HBT with graded-gap contacts to both base and emitter was demonstrated. GRA

**N88-18821#** San Diego State Univ., Calif.
**PHOTOCONDUCTOR SWITCH AND CIRCUIT ANALYSIS Final Report, Feb. - Dec. 1986**
C. C. Wu and C. T. Chang Aug. 1987 13 p
(Contract N66001-85-D-0203)
(AD-A188168; NOSC-TD-1132) Avail: NTIS HC A03/MF A01 CSCL 09A

One hundred-picosecond optical pulses with a continuous repetition frequency, from 30 MHz to greater than 1 GHz, were generated by direct RF modulation of a self-pulsating laser diode. With peak laser pulse power about 18 MW and negligible DC optical power, these optical pulses were used to activate a photoconductive switch for real-time signal sampling. GRA

**N88-18822#** Stanford Univ., Calif. Lab. of Physics.
**JOINT SERVICES ELECTRONICS PROGRAM Annual Progress Report, 1 Apr. 1986 - 31 Mar. 1987**
D. M. Bloom, R. L. Byer, S. E. Harris, G. S. Kino, and C. F. Quate 15 Oct. 1987 68 p
(Contract N00014-84-K-0327)
(AD-A188173; GL-4287) Avail: NTIS HC A04/MF A01 CSCL 20F

The central theme of our work at Ginzton is the development of new material and device technologies, along with novel techniques for characterization and measurement, that will allow ultra-high speed electronic and optical processing of information. The different work units of this proposal interconnect the physics and technology of linear and nonlinear optical materials and fibers with new measurement tools which provide unprecedented spatial and temporal resolution. The following paragraphs summarize each of these work units. Professor Bloom's work has been concerned with developing laser techniques for obtaining both time and frequency domain measurements of high speed electrical circuits. His efforts have been concerned with both electrooptic voltage sampling in gallium arsenide and with real time charge sampling in silicon. Using these techniques Bloom and his students have demonstrated 2 ps time resolution, and circuits with response into the 100 GHz range. A particularly exciting achievement during

this contract period was the development of the charge sensing technique in silicon. This concept has in turn allowed the development of a very simple silicon optical modulator with extraordinary potential. GRA

**N88-18823#** Lawrence Livermore National Lab., Calif.
**LINbO3:Ti DIRECTIONAL-COUPLER MODULATORS FOR HIGH-BANDWIDTH, SINGLE-SHOT INSTRUMENTATION SYSTEMS OPERATING AT 800 nm**
M. Lowry, D. Jander, G. Lancaster, P. Kwiat, G. McWright, R. T. Peterson, W. Tindall, and F. Roeske 28 Oct. 1987 7 p Presented at the Symposium on Fiber Optics and Integrates Optoelectronics, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-003830; UCRL-96249; CONF-8708198-1) Avail: NTIS HC A02/MF A01

We update our work on optical directional-coupler modulators (ODCMs) for single-shot, analog instrumentation systems operating at approx. 800 nm. We can now fabricate directional-coupler devices that have one input and two output pigtails, with insertion losses of 8.9 dB on average. Data for the ODCMs indicate an impulse response of less than 40 ps. We have implemented these devices in an ultrafast, X-ray measurement system. We discuss our data from this implementation and their implications for continued ODCM development. DOE

**N88-18824#** Lawrence Livermore National Lab., Calif.
**THE EFFECTS OF VARIOUS CONDUCTOR COMPONENTS ON Nb3Sn FILAMENT PRESTRAIN IN CABLE-IN-CONDUIT CONDUCTORS**
J. R. Miller and L. T. Summers 11 Jun. 1987 10 p Presented at the Conference on Advances in Cryogenic Engineering, St. Charles, Ill., 14 Jun. 1987
(Contract W-7405-eng-48)
(DE88-003956; UCRL-95997; CONF-8706125-24) Avail: NTIS HC A02/MF A01

We investigated the state of thermal prestrain in cable-in-conduit conductors modified by incorporating tungsten core wires in cable subelements. The relatively low thermal contraction and high modulus of tungsten is intended to offset the compressive thermal prestrain introduced in the conductor filaments by the differential contraction of the stainless-steel sheath, copper stabilizer, and Nb sub 3 Sn. Critical current as a function of applied strain was measured at 12 T for conductor samples with tungsten core wires and control specimens with copper cores. The degree of thermal precompression was determined from measured ratios of initial critical current with no external strain to the maximum critical current observed with varying applied strain. DOE

**N88-18825#** Stanford Linear Accelerator Center, Calif.
**DESIGN AND FABRICATION OF ADVANCED HYBRID CIRCUITS FOR HIGH ENERGY PHYSICS**
G. M. Haller, J. Moss, D. R. Freytag, D. Nelson, A. Yim, and C. C. Lo Oct. 1987 6 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987 Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00515)
(DE88-004392; SLAC-PUB-4418; CONF-871006-22) Avail: NTIS HC A02/MF A01

Current design and fabrication techniques of hybrid devices are explained for the Drift Chamber and the Liquid Argon Calorimeter for the Stanford Linear Collider Large Detector (SLD). Methods of developing layouts, ranging from hand-cut templates to advanced designs utilizing computer aided design (CAD) tools with special hybrid design software were applied. Physical and electrical design rules for good yield and performance are discussed. Fabrication and assembly of the SLD hybrids are described. DOE

**N88-18826#** Stanford Linear Accelerator Center, Calif.
**RF PULSE COMPRESSION DEVELOPMENT**
Z. D. Farkas and J. N. Weaver Oct. 1987 17 p
(Contract DE-AC03-76SF-00515)
(DE88-004818; SLAC/AP-59) Avail: NTIS HC A03

The body of this paper discusses the theory and some rules for designing a multistage Binary Energy Compressor (BEC) including its response to nonstandard phase coding, describes some proof-of-principle experiments with a couple of low power BECs, presents the design parameters for some sample linear collider RF systems that could possibly use a BEC to advantage and outlines in the conclusion some planned R and D efforts. DOE

**N88-18827#** Naval Research Lab., Washington, D.C. Plasma Physics Div.
**ION ENERGY DIAGNOSTICS FOR VOLTAGE DETERMINATIONS IN PLASMA-EROSION-OPENING-SWITCH EXPERIMENTS**
F. C. Young, J. M. Neri, B. V. Weber (JAYCOR, Vienna, Va.), R. J. Commisso, S. J. Stephanakis, and T. J. Renk 3 Dec. 1987 35 p
(Contract DE-AI08-79DP-40092)
(DE88-004822; NRL-MR-6059) Avail: NTIS HC A03/MF A01

A number of nuclear techniques have been developed and used to measure ion-diode voltages for plasma-erosion-opening-switch (PEOS) experiments on the Gamble II pulsed-power generator at NRL. The voltage is determined by measuring the energy of protons or deuterons from the diode. The techniques include neutron time-of-flight, neutron-intensity mesurements, delayed activations, and stacked-foil activations. The diagnostics have evolved as the voltage developed in PEOS experiments have increased from less than 1 MV to more than 4 MV. Examples of these diagnostics are presented, and the extension of some of these techniques to voltages of more than 20 MV is described. DOE

**N88-18828#** Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
**MODULES OF NANOSECOND LOGIC ELECTRONICS SYSTEM WITH COMPUTER CONTROL**
Yu. B. Bushnin, A. A. Denisenko, A. F. Dunajtsev, D. A. Leonenko, N. K. Marchikhin, and V. A. Senko 1986 16 p In RUSSIAN
(DE88-700190; IFVE-OEA-86-12) Avail: NTIS (US Sales Only) HC A03/MF A01

Nanosecond electronics modules, namely fan-out, amplifier-discriminator, amplifier-shaper, logic units of three types and delays of two types, implemented according to the VECTOR standard are described. Parameters of the modules (thresholds, durations, number of permitted channels for inputs pulses) are changed either manually by switchers on the front panel or by commands from a computer. The modules provide high speed (up to 100 MHz) and delay of 6 to 10 nsec. The presence of direct and inverse outputs enables to realize different logic functions. DOE

**N88-18829#** Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
**DETERMINATION OF DISTRIBUTED RESISTANCE OF BASE OF BIPOLAR TRANSISTORS MEASURING NOISE SPECTRAL DENSITIES**
R. N. Krasnokutskij, L. L. Kurchaninov, N. N. Fedyakin, R. S. Shuvalov, and V. V. Tikhonov 1986 11 p In RUSSIAN
(DE88-700197; IFVE-ONF-OEA-86-5) Avail: NTIS (US Sales Only) HC A03/MF A01

It is shown that the base distributed resistance, r, may be determined by measuring spectral noise density at the definite frequency. The parameters, r, for transistors GT311, GT329B, KT316D, KT355A, KT363A, KT371A, KT372A, KT382, KT3127A are determined. DOE

**N88-18830#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
**LIMITING EFFICIENCY OF A THERMIONIC DIODE**
I. I. Kasikov and P. P. Shcherbinin 1986 22 p In RUSSIAN
(DE88-700598; FEI-1815) Avail: NTIS (US Sales Only) HC A03/MF A01

A total volt-ampere characteristics (VAC) of an ideal thermionic diode is built, its properties are studied. The expression for electron efficiency, eta, of the ideal diode is obtained, properties of eta=const diagram family are established. The expression for a barrier index of the envelope of the VAC family of the ideal diode is also obtained. The upper and lower limit of electron efficiency of low-voltage arc is shown. DOE

**N88-18831#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj.
**GERA COMPUTER CODE FOR CALCULATION OF TWO-DIMENSIONAL ELECTROMAGNETIC FIELDS IN RESONATORS AND ELECTRON-OPTICAL SYSTEMS BY THE FINITE ELEMENT METHOD**
S. A. Khapalov 1986 20 p In RUSSIAN
(DE88-700678; ITEF-39-1986) Avail: NTIS (US Sales Only) HC A03/MF A01

The GERA computer code designed for the computation of 2-D electromagnetic fields in resonators and electron-optical systems by the finite element method is described. Tetragonal and partial quadratic subparametric finite elements are used. The algebraic part of the program is realized on the basis of the program complex of the nonlinear algebra, which allows solution of the system of linear equations and analysis of the spectral composition of 10000 order matrices by direct methods using external memory. The results of numerical experiments are presented. DOE

**N88-18832#** Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
**EXPERIMENTAL AND MATHEMATICAL INVESTIGATION OF RESPONSE CHARACTERISTICS AND AGING PHENOMENA IN SAFETY FUSE ELEMENTS Ph.D. Thesis [EXPERIMENTELLE UND RECHNERISCHE UNTERSUCHUNG VON ANSPRECHKENNLINIEN UND ALTERUNGSVORGAENGEN BEI SICHERUNGSSCHMELZLEITERN]**
Matthias Hofmann 1987 190 p In GERMAN
(ETN-88-91478) Avail: NTIS HC A09/MF A01

Fuse elements were tested in air and sand for currents between 80 and 210 A, and were investigated using the finite element programming system ADIMAT. The long term melting behavior of fuses with soldered coating is discussed. The dissociation phenomena in fuse-solder pairs are explained. The aging behavior in case of cyclic overcurrent loading was determined. The response characteristics of fuse-solder pairs were obtained using the finite element method. The test results provide the heat conduction and heat capacity characteristics of safety sand as a function of temperature. ESA

**N88-18833#** Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
**THE OPERATIONAL BEHAVIOR OF MICROPROCESSOR-CONTROLLED AND PULSED INVERTER-FED SYNCHRONOUS MACHINES WITH PERMANENT MAGNET EXCITATION Ph.D. Thesis [ZUM BETRIEBSVERHALTEN MIKRORECHNERGEREGELTER PULSWECHSELRICHTERGESPEISTER UND N MIT PERMANENTMAGNETERREGUNG]**
Bernd Orlik 1987 191 p In GERMAN
(ETN-88-91479) Avail: NTIS HC A09/MF A01

A mathematical model for synchronous machines excited with permanent magnets was developed for the investigation of the steady and dynamic behavior of inverter-fed three-phase drives. The characteristics of inverter-fed three-phase drives and their subsystems are depicted. A microprocessor-based vectorial pulse width modulation method was developed. The armature current control, speed control, field reduction in synchronous machines excited with permanent magnets, and feeding with nonsinusoidal currents of synchronous machines excited with permanent magnets were analyzed. The location of the poles was determined by the identification of the initial location. This results in controlled starting of the drive immediately after switching on the control. ESA

**N88-18834#** Allied Bendix Aerospace, Kansas City, Mo.
**ROBOTIC ASSEMBLY AND TESTING OF ROTARY SOLENOIDS Final Report**
J. R. Lembke Feb. 1987 42 p
(Contract DE-AC04-76DP-00613)
(BDX-613-3663) Avail: NTIS HC A03/MF A01

Robotic automation of rotary solenoid assembly and testing operations was investigated. A robot was used to evaluate the automation of solenoid torque measurements. A measurement arrangement was devised in which the robot connects the solenoid shaft to a torque sensor, rotates the solenoid housing, and correlates rotational data with digitized torque readings. Results are typically in good agreement with those from the manually operated universal tension tester. Stack assembly of the rotary solenoid was attempted using another robot. Starting with parts in a component tray, the robot assembles the solenoid vertically in a precision cavity and installs retaining rings on the shaft. Special tooling and a remote center compliance device in the robot wrist have enabled the prototype assembly process to be largely successful, in spite of extremely small clearances between mating parts. Author

**N88-18835*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MICROWAVE RESPONSE OF AN HEMT PHOTOCONDUCTOR**
P. C. Claspy (Case Western Reserve Univ., Cleveland, Ohio.) and K. B. Bhasin Jan. 1988 10 p Presented at the Optoelectronics and Laser Applications in Science and Engineering (O-E/LASE), Los Angeles, Calif., 10-15 Jan. 1988; sponsored in part by The Society of Photo-Optical Instrumentation Engineers
(NASA-TM-100819; E-4009; NAS 1.15:100819) Avail: NTIS HC A02/MF A01 CSCL 09A

Interdigitated photodetectors of various geometries have been fabricated on GaAlAs/GaAs heterostructure material. Optical response characteristics of these devices have been examined at both dc and microwave frequencies. The microwave response, at frequencies to 8 GHz, was studied by illuminating the devices with the output of an internally modulated GaAlAs diode laser. Results of these measurements are presented and compared with that of GaAs photoconductors. Author

**N88-18836#** Foersvarets Forskingsanstalt, Stockholm (Sweden).
**MICROWAVE TUBES: LITERATURE SURVEY NO. 8 COMPRISING YEAR 1986**
L. Lundgren Oct. 1987 134 p
(PB88-138375; FOA-C-30467-3) Avail: NTIS HC A07/MF A01 CSCL 09A

The literature on generation/amplification of microwaves (UHF to sub-mm waves) as referenced in data bases or published by journals and at conferences during the year 1986 was collected and commented by short notes. The present issue is the 8th in a series of yearly reports covering all conventional microwave tubes including gyrotrons as well as less conventional tubes like cusptrons, orotrons, vircators, etc. References and comments on free electron masers and other new concepts of generating/amplifying microwave power indicate the state of art and the trends of future development. Important technological issues like electron guns, cathodes and electron beams up to GW-level are also included in the text. Author

**N88-18837#** Argonne National Lab., Ill.
**LEAD-ACID LOAD-LEVELING BATTERY TESTING AT ARGONNE NATIONAL LABORATORY**
J. F. Miller, T. P. Mulcahey, C. C. Christianson, J. J. Marr, and J. A. Smaga 1987 7 p Presented at the 8th Battery and Electrochemical Contractors' Conference, Tysons Center, Va., 16 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-002853; CONF-871121-1) Avail: NTIS HC A02/MF A01

Argonne National Laboratory (ANL) has conducted an extensive evaluation of an advanced lead-acid battery development for load-leveling applications. The battery technology was developed

by the Exide Corporation under a DOE-sponsored cost-shared R and D contract with ANL during 1979-1982. The objective of that program was to increase battery life from 2000 to 4000 deep discharge cycles while maintaining or reducing initial battery cost. Full-size, 3100-Ah cells were fabricated by Exide and assembled into one 6-cell and two 3-cell batteries. These 36-kWh and 18-kWh batteries were delivered to ANL in April 1982 for testing and evaluation. Southern California Edison is currently installing a 10-MW, 40-MWh load-leveling facility comprised of batteries based on this design. DOE

**N88-18838#** Argonne National Lab., Ill.
**EVALUATION OF ADVANCED LEAD-ACID BATTERIES DEVELOPED FOR LOAD-LEVELING APPLICATIONS**
J. F. Miller and T. P. Mulcahey 1987 9 p Presented at the 172nd Meeting of the Electrochemical Society, Honolulu, Hawaii, 18 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002871; CONF-871027-41) Avail: NTIS HC A02/MF A01

Argonne National Laboratory has conducted an extensive evaluation of an advanced lead-acid battery developed by Exide Corporation for load-leveling applications. This paper presents the results of tests and analyses conducted on three 3100-Ah batteries over a five-year period. The Exide batteries demonstrated their high reliability and long life by completing over 2300 deep discharge cycles under accelerated life testing conditions at 50 C, the equivalent of over 6400 cycles or 25 years of operation for the electric utility application. This paper also describes the thermal characteristics and operational reliability of this battery technology. DOE

**N88-18839#** Argonne National Lab., Ill.
**LITHIUM/DISULFIDE BATTERY R AND D**
T. D. Kaun, W. DeLuca, J. Lee, L. Redey, and P. A. Nelson 1987 5 p Presented at the 8th Battery and Electrochemical Contractors' Conference, Tysons Corner, Va., 16 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-003032; CONF-871121-3) Avail: NTIS HC A02/MF A01

The focus of molten-salt cell R and D in the past year at Argonne National Laboratory has been on developing an understanding of the excellent performance and stability of a lithium/disulfide cell using LiCl-LiBr-KBr electrolyte. For further improvement, we have initiated development of a rod-electrode cell design and design of cells which can tolerate overdischarge and overcharge abuse. Earlier Li/FeS2 cells offered performance quite below expectations and had high capacity decline rates: 0.10 to 0.25 percent per cycle. Approaches for reducing the capacity decline rates of the earlier cells also reduced cell performance. However, our improved Li/FeS2 cell tests indicate good prospects for attaining cell development goals of specific energy of 200 Wh/kg at a 4-h discharge rate, a specific power of 200 W/kg at 80 percent depth of discharge, and a cycle life of 1000 cycles. DOE

**N88-18840#** California Univ., Berkeley. Lawrence Berkeley Lab.
**BALLISTIC DEFICITS IN PULSE SHAPING AMPLIFIERS**
B. W. Loo, F. S. Goulding, and Dexi Gao Sep. 1987 7 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987 Prepared in cooperation with Academia Sinica, Beijing, China
(Contract DE-AC03-76SF-00098)
(DE88-003908; LBL-23356; CONF-871006-24) Avail: NTIS HC A02/MF A01

This report considers the common problem of ballistic deficit which is the loss of output signal amplitude due to the interplay between the finite charge collection times in a detector and the characteristic time constants of the amplifier. Quantitative estimates of ballistic deficits have been developed by using numerical integration techniques on a microcomputer and by exact calculations using Laplace transforms. A new practical procedure has been developed in which an actual amplifier with even an unspecified complex-pole network can be accurately related to an equivalent semi-Gaussian shaping network whose exact solution is known. Simple formulas for estimating ballistic deficits and resulting degradation in spectral energy resolutions are given. DOE

**N88-18841#** Sandia National Labs., Albuquerque, N. Mex.
**IMPROVING BATTERY RELIABILITY BY USING REGRESSION TREES**
E. V. Thomas, C. D. Jaeger, and S. C. Levy 1988 8 p Presented at the 3rd Annual Battery Conference on Applications and Advances, Long Beach, Calif., 12 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004539; SAND-87-2977C; CONF-880133-1) Avail: NTIS HC A02/MF A01

One way to improve the reliability of primary cells is to use a screening procedure, based on nondestructive measurements, to eliminate cells that will yield poor performance. For a screening procedure to be effective, it is necessary that a relationship between the nondestructive measurements and future performance exists and be understood. Regression trees are used as a tool to model the relationship between nondestructive measurements (in this case, parameters derived from complex impedance analysis) and performance. It is demonstrated that use of regression trees allows for discrimination between fresh and aged cells. DOE

**N88-18842#** Hauptverband der Gewerblichen Berufsgenossenschaften, e. V., Bonn (West Germany).
**CONSTRUCTION OF CONTROL SYSTEMS WITH DIVERSIFIED REDUNDANCY FOR ELECTRICAL MACHINES [AUFBAU ELEKTRISCHER MASCHINENSTEUERUNGEN MIT DIVERSITAERER REDUNDANZ]**
W. Grigulewitsch, K. Meffert, and G. Reuss 1986 75 p In GERMAN
(BIA-5/86; ISSN-0173-0487; ETN-88-91066) Avail: NTIS HC A04/MF A01

Redundant control systems for electrical machines were investigated from a safety engineering point of view. The boundary conditions and requirements for such systems, as well as the errors to be taken into account are discussed. The principle of diversified redundancy is explained. The peripheral commands are discussed. The degree of diversity, the use of programmable processing units, the use of hardware comparators, the signal processing, and the systems specifications testing are presented. Technical advice for the realization is given. Reliability, availability and cost are discussed. ESA

**N88-18791*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**NEW MODE SWITCHING ALGORITHM FOR THE JPL 70-METER ANTENNA SERVO CONTROLLER**
J. A. Nickerson *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 147-153 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09A

**N88-18795*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SETI DATA CONTROLLERS**
R. M. Gosline *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 184-190 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09A

**N88-18953*#** Hughes Aircraft Co., Fullerton, Calif. Environmental Engineering Dept.
**RANDOM VIBRATION (STRESS SCREENING) OF PRINTED WIRING ASSEMBLIES**
Gilbert J. Bastien *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 111-147 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 09A

# 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

**N88-18843#** Aerometrics, Inc., Mountain View, Calif.
**DIAGNOSTICS FOR RESEARCH IN ATOMIZATION AND TURBULENT TWO-PHASE FLOWS Annual Report, 31 Jul. 1986 - 31 Jul. 1987**
William D. Bachalo 28 Jul. 1987 17 p
(Contract F49620-86-C-0078)
(AD-A187338; AFOSR-87-1417TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Innovative techniques for obtaining particle size and velocity are being investigated. The four methods are phase Doppler, ratiometric light scatter detection, Lagrangian frame particle analyzer, and scattered light heterodyne interferometry. Although these methods have overlapping capabilities, each offers additional possibilities for providing heretofore unavailable data. The phase Doppler method has been highly refined and provides reliable particle size and velocity measurements. However, research has been required on the light scattering mechanisms due to nonuniform-light scattering theory and experimental observations have required the expansion of the theory to include the affects of nonuniform illumination. Under certain conditions, the detection of refracted light where none is predicted, remains as a question to be resolved. These questions apply to all of the methods addressed. However, the ratiometric techniques may be used in the on-axis forward scatter light detection mode. This will allow the measurement of irregular-shaped particles moving at high speed using light configuration, the system is limited to dilute particle fields. Currently, the theoretical analysis and optical configuration have been completed and preliminary tests have shown that the basic concept will work. GRA

**N88-18844#** Pennsylvania State Univ., State College. Applied Research Lab.
**A HYDRODYNAMIC ANALYSIS OF FLUID FLOW BETWEEN MESHING SPUR GEAR TEETH M.S. Thesis**
M. J. Wittbrodt and M. J. Pechersky Oct. 1987 115 p
(Contract N00024-85-C-6041)
(AD-A187671; ARL/PSU/TR-87-006) Avail: NTIS HC A06/MF A01 CSCL 20D

A one dimensional analysis of the fluid pumping action resulting from the meshing of spur gears was performed by writing a computer algorithm. Two separate analyses were conducted; one using incompressible and the other using compressible flow theory. The incompressible flow calculations correspond to heavily lubricated gears whereas the compressible flow calculations are representative of lightly lubricated gears. The analysis demonstrated that the velocity of the discharged fluid reached high velocities for both cases. The high meshing rate of the teeth along with the small discharge area is the cause for the high fluid velocities. Certain geometric design variables of the gears were seen to affect the peak velocities for each case. The variables most significantly affecting the peak velocity appear to be the drive ratio and the face width. The high velocities may contribute to the noise generated during meshing of gear teeth due to the jet noise as a result of the high velocity jets impinging on the enclosures surrounding the gears and the formation of shock waves at the exit plane of the teeth. GRA

**N88-18845#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**PERFORMANCE EVALUATION OF PLATE-FIN HEAT EXCHANGERS M.S. Thesis**
David M. Ceci Jun. 1987 83 p
(Contract N00228-85-G-3262)
(AD-A187798) Avail: NTIS HC A05/MF A01 CSCL 13A

The performance parameters proposed by Soland et al. were used to perform a comparison of the Kays and London plate - finned surfaces for heat exchangers constructed from stainless steel, mild steel, aluminum, and cooper. Three additional comparison criteria were also investigated by modifying the proposed parameters. When using stainless steel, the louvered plate - finned surface 1/4 (b) 0 11.1, is the best, but when using mild steel, aluminum, or copper, the wavy - fin plate - finned surface 17.8 - 3/8w is the best of those considered. GRA

**N88-18846#** Massachusetts Inst. of Tech., Cambridge.
**STRUCTURE OF SHEAR FLOW TURBULENCE AND ITS CONTROL Final Report, Nov. 1984 - May 1987**
Joseph H. Haritonides and Marten T. Landahl Sep. 1987 13 p
(Contract F49620-83-C-0019)
(AD-A187909; AFOSR-87-1661TR) Avail: NTIS HC A03/MF A01 CSCL 20D

A nonlinear theory of turbulent coherent structures near walls has been developed based on the assumption that the eddies are flat, with large horizontal dimensions compared to their thickness. Turbulence in the outer part of the boundary-layer may be modelled as a linearly driven system with nonlinearities confined to the near wall region. A new model for near wall turbulence based on the concept of an instantaneous mixing length gives a mean velocity profile valid from the wall to the beginning of the log region. The effect of Large Eddy Break-up (LEBU) devices on the boundary layer was modelled as a wake deficit. The wake acts as a barrier to structures crossing the wake. Measurements of the skin friction behind LEBU's using a variant of the Stanton tube are in agreement with other techniques. GRA

**N88-18847#** Vrije Universiteit, Brussels (Belgium). Dept. of Fluid Mechanics.
**RADIAL MIXING IN TURBOMACHINES Annual Report, 1 Sep. 1985 - 31 Aug. 1986**
J. DeRuyck, Ch. Hirsch, and E. Toorman 15 Apr. 1987 80 p
(Grant AF-AFOSR-0167-85)
(AD-A188028; VUB-TN-39; AFOSR-87-1423TR) Avail: NTIS HC A05/MF A01 CSCL 20D

The main tools for the prediction of convective radial mixing are developed. The secondary flows needed for the convective mixing are found from pitch averaged vorticity equations combined with integral methods for the computation of 3d end-wall boundary layers, 3d profile boundary layers and 3d asymmetric wakes. This integral approach requires less approximations than previous radial mixing theories and only three empirical constants are required. The convective mixing coefficient of Adkins and Smith is found from the resulting secondary flow velocities. The method is applied to some standard test cases, where secondary flow patterns are compared with available test data. GRA

**N88-18848#** Texas Univ., Austin. Coll. of Engineering.
**A CODE DEVELOPMENT SYSTEM FOR COMPUTATIONAL FLUID DYNAMICS Final Report, 1 Oct. 1986 - 30 Sep. 1987**
Dale A. Anderson 30 Sep. 1987 11 p
(Grant AF-AFOSR-0293-86)
(AD-A188050; AFOSR-87-1708TR) Avail: NTIS HC A03/MF A01 CSCL 20D

The first and largest color Sun 3/160C in the CFD workstation network was purchased with funds made available through this grant. This workstation has been used as a server and general computational node, as well as a workstation. Research Projects: Development of Adaptive Grid Schemes Based on Poisson Grid Generators; A Zonal Method for Extending the Applicability of the Parabolized Navier Stokes Equations; and Numerical Simulation of Helicopter Rotor Flowfields. GRA

**N88-18849#** Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Engineering Mechanics.
**SPECIALIZED INSTRUMENTATION FOR COMPUTATIONAL FLUID DYNAMICS RESEARCH Final Report, 15 Jul. 1984 - 14 Feb. 1986**
K. N. Ghia Jun. 1987 4 p

(Grant AF-AFOSR-0275-84)
(AD-A188160; AFOSR-87-1175TR) Avail: NTIS HC A02/MF A01 CSCL 12F

A Perkin-Elmer 3250 MPS computer system was purchased. To assure more reliable operation, negotiations to replace this with a model 3280 MPS system were completed. GRA

**N88-18850#** Ballistic Research Labs., Aberdeen Proving Ground, Md.

**COMPUTATIONAL STUDIES OF WAVE-SHAPING IN A BLAST SIMULATOR BY PERFORATED PLATES IN THE DRIVER Final Report**

D. M. Hisley Mar. 1987 46 p
(AD-A188200; BRL-TR-2791) Avail: NTIS HC A03/MF A01 CSCL 20D

Computational simulation of shock tubes with baffles on their driver sections were performed using the (BRL) Quasi-One-Dimensional (Q1D) computer code. The credibility of the code was established through comparisons with experimental data. A numerical parametric study was performed in which baffle positions and area openings in a computational model of a candidate Large Blast/Thermal Simulator (LB/TS) were manipulated until blast wave forms at weapon yields of interest were obtained. GRA

**N88-18851#** Office of Naval Research, London (England).

**INTERNATIONAL CONFERENCE ON INDUSTRIAL AND APPLIED MATHEMATICS**

Eugene F. Brown 13 Oct. 1987 12 p Conference held in Paris, France, Jul. 1987
(AD-A188251; ONRL-7-030-C) Avail: NTIS HC A03/MF A01 CSCL 20D

This conference, held in July 1987 in Paris, France, gave clear evidence of the contribution of applied mathematics to the field of computational fluid mechanics, particularly in the fields of discrete vortex methods, multigrid methods, and lattice gas hydrodynamics. Selected presentations are reviewed. GRA

**N88-18852*#** Wales Univ., Swansea. Inst. for Numerical Methods in Engineering.

**FINITE ELEMENT METHODS OF ANALYSIS FOR HIGH SPEED VISCOUS FLOWS Final Report, 1 Oct. 1986 - 30 Sep. 1987**

30 Sep. 1987 18 p
(Grant NAGw-478)
(NASA-CR-182529; NAS 1.26:182529) Avail: NTIS HC A03/MF A01 CSCL 20D

Over the past three years a finite element based procedure for the solution of high speed viscous compressible flows was developed. The approach followed was to compute steady state solutions via a false transient, using an explicit time stepping scheme, and to attempt to improve the solution quality by incorporating adaptive mesh procedures. The main thrust of the work was to continue on the extension of the approach to the solution of some realistic compressible viscous flows. When flows at high Reynolds number are investigated, is soon becomes apparent that explicit techniwues have to be supplemented if they are to deal effectively with the large variations in element size and aspect ratio which characterize the computational grids necessary for adequate resolutin of the primary flow features. For this reason, the Taylor-Galerkin solution algorithm was rewritten in an explicit/implicit form. Solutions were computed for the problems of a flow past a flat plate, M-3, Re-100; shock/boundary layer interaction, M-2, Re-296000; flow over a compression corner, M-11.68, Re246000; and unifrom flow past a circular cylinder, M-6.34, Re-39770. A summary of the results is included and demonstrates the numerical performance of the scheme. Author

**N88-18853*#** Michigan State Univ., East Lansing. Turbulence Structure Lab.

**CHANGES IN THE TURBULENT BOUNDARY LAYER STRUCTURE ASSOCIATED WITH NET DRAG REDUCTION BY OUTER LAYER MANIPULATORS Final Report**

N. Rashidnia and R. E. Falco Sep. 1987 215 p
(Grant NAG1-302)
(NASA-CR-178152; NAS 1.26:178152) Avail: NTIS HC A10/MF A01 CSCL 20D

A specially designed wind tunnel was used to examine the effects of tandemly arranged parallel plate manipulators (TAPPMs) on a turbulent boundary-layer structure and the associated drag. Momentum balances, as well as measurements of the local shear stress from the velocity gradient near the wall, were used to obtain the net drag and local skin friction changes. Two TAPPMs, identical except for the thickness of their plates, were used in the study. Results with .003 inch plates were a maximum net drag reduction of 10 percent at 58 beta sub o (using a momentum balance). At 20 beta sub o, simultaneous laser sheet flow visualization and hot-wire anemometry data showed that the Reynolds stress in the large eddies was significantly reduced, as were the streamwise and normal velocity components. Using space-time correlations the reductions were again identified. Furthermore, quantitative flow visualization showed that the outward normal velocity of the inner region was also significantly decreased in the region around 20 beta sub o. However, throughout the first 130 beta sub o, the measured sublayer thickness with the TAPPMs in place was 15 to 20 percent greater. The data showed that the skin friction, as well as the structure of the turbulence, was strongly modified in the first 35 beta sub o, but that they both significantly relaxed toward unmanipulated boundary layer values by 50 beta sub o. Author

**N88-18854#** Mechanical Technology, Inc., Latham, N. Y.

**FREE-PISTON STIRLING ENGINE DIAPHRAGM-COUPLED HEAT-ACTUATED HEAT PUMP COMPONENT TECHNOLOGY PROGRAM, PHASE 1B Final Report**

R. A. Ackermann Sep. 1987 130 p
(Contract DE-AC05-84OR-21400)
(DE88-003653; ORNL/Sub-83-47985/1) Avail: NTIS HC A07/MF A01

In Phase 1 of the Diaphragm-Coupled Heat Pump Compressor Development Program, a free piston Stirling engine (FPSE) driven heat pump power module was designed, fabricated, and tested. The module consisted of a natural gas combustor, FPSE, hydraulic transmission, and refrigerant compressor. A problem encountered with this hardware was the shortfall in rated heating and cooling capacity. To determine the causes of the shortfall, an investigation was conducted during Phase 1A. During Phase 1B, several of the more important losses identified in Phase 1A were investigated. In particular, hardware associated with the critical clearance seals in the hydraulic transmission was modified, and several different hydraulic transmission fluids were tried. The results were encouraging in that improvements made to the hydraulic transmission produced a capacity increase from 1.0 to over 2.0 tons of cooling. However, the increase to 3.0 tons was not achieved. The testing did show conclusively, though, that the internal counterweight was responsible for the largest loss in the hydraulic transmission and, in order to achieve a significant increase in capacity, the counterweight would have to be removed. DOE

**N88-18855#** Sandia National Labs., Albuquerque, N. Mex. Aerothermodynamics Div.

**AN EXPERIMENTAL INVESTIGATION OF THE HYDRODYNAMIC AND HEAT-TRANSFER BEHAVIOR OF AQUEOUS FOAM IN LAMINAR TUBE FLOW**

B. F. Blackwell and Keri Butler Sobolik Dec. 1987 46 p
(Contract DE-AC04-76DP-00789)
(DE88-004954; SAND-85-1922) Avail: NTIS HC A03/MF A01

The structure of both static and dynamic aqueous foam samples has been observed photographically. Velocity profiles for a pipe-flow configuration were measured using a hot-film anemometer and an indirect calibration method. Temperature profiles at the end of a three-meter-long test section were measured using a thermocouple probe on a traversing mechanism. A finite-control-volume model of the energy equation for the flowing foam and the surrounding pipe was developed and compared with experimental results. DOE

**N88-18856#** Technische Univ., Hanover (West Germany). Sonderforschungsbereich 211.
**OPERATING LOADING OF PIPING SYSTEMS Final Report [BETRIEBSBEANSPRUCHUNGEN BEI ROHRLEITUNGSSYSTEMEN]**
J. Brumm 1986 51 p In GERMAN
(ETN-88-91057) Avail: NTIS HC A04/MF A01

The fluid-structure interaction during a pressure perturbation in piping systems was investigated. Pressure shocks are due to the switching of pumps and to blocking and control systems. The equations for an axisymmetric cylindrical pipe are presented. The relations for an axisymmetric, compressible, inviscid flow under unsteady conditions are given. The limitations of the classical pressure shock theory are shown. The dynamic effects can be simulated by taking into account the inertia terms in axial and radial direction for the fluid as well as for the pipe wall. The results of measurements on a test stand demonstrate the feasibility, but also the limitations of the presented model. ESA

**N88-18857** Colorado Univ., Boulder.
**TRAVELLING WAVES AND CHAOS IN DOUBLE-DIFFUSIVE CONVECTION Ph.D. Thesis**
Anil Enoch Deane 1987 208 p
Avail: Univ. Microfilms Order No. DA8723449

Numerical simulations of two-dimensional thermosolutal convection were carried out employing either periodic or stress-free, impermeable boundary conditions in the horizontal. A significant finding is that travelling waves, in which a pattern of rolls translates horizontally, are the preferred form into which an oscillatory instability develops; standing, modulated and chaotic waves are also found. Hysteretic and nonhysteretic transitions between the different wave states and steady convection are investigated, and are in general agreement with a recently developed bifurcation theory based on the symmetries of the system. The simulations are complemented by considering equations that model the system at small amplitudes. Travelling waves are found in the model equations similar to those observed in the full simulations, along with a variety of modulated waves, only some of which are seen in the simulations. Simulations of convection in a finite container of large aspect ratio reveal solutions that are closely related to those obtained with periodic conditions. An unexpected feature in the simulations is that the travelling waves reverse their direction of propagation in an episodic manner. Modulated waves with two and three frequencies are also found, but they do not change their sense of propagation. Dissert. Abstr.

**N88-18858** North Carolina State Univ., Raleigh.
**THREE-DIMENSIONAL FLOW FIELDS PAST REENTRY VEHICLES Ph.D. Thesis**
Horng-Tsann Yang 1987 75 p
Avail: Univ. Microfilms Order No. DA8723555

The development of an upwind relaxation scheme for obtaining steady state solution to the compressible Navier-Stokes equations in generalized coordinates is described. The method is second order accurate and naturally dissipative. It uses third order flux splitting of the convective and pressure terms and second order central differencing of shear and heat flux terms. A line Gauss-Sidel relaxation approach is used. The scheme is unconditionally stable as applied to a partial differential model equation. The algorithm is demonstrated for three dimensional flow past a reentry vehicle. Dissert. Abstr.

**N88-18859** Oklahoma State Univ., Stillwater.
**LAMINAR FLOW HEAT TRANSFER DOWNSTREAM FROM U-BENDS Ph.D. Thesis**
Amanie Nassif Abdelmessih 1987 301 p
Avail: Univ. Microfilms Order No. DA8724524

The laminar flow heat transfer downstream from the unheated, vertical bends in horizontal U-tubes with electrically heated straight tube sections was investigated. For each test section, local axial and peripheral wall temperatures were measured and the local peripheral heat transfer coefficients at the various locations were calculated. The investigation permitted a better understanding of the interaction of the primary, secondary and tertiary flow patterns, i.e., the combination of forced and natural convection with the centrifugal effects. Also, a correlation was developed, which predicts the heat transfer coefficient downstream from an unheated U-bend, and which can be extended to straight tubes. Dissert. Abstr.

**N88-18860** Columbia Univ., New York, N.Y.
**CHAOS, MAPPINGS AND SPATIAL COMPLEXITY IN FLUIDS Ph.D. Thesis**
Joel Gary Chaiken 1987 193 p
Avail: Univ. Microfilms Order No. DA8723993

The spatial complexity that evolves by following marked particles of fluid in a Stokes flow is shown to be explainable in terms of the chaos exhibited by the underlying Hamiltonian equations of motion. The fluid system consists of the flow of a very viscous fluid, i.e., glycerine in the annulus between two eccentric cylinders which alternately and slowly rotate. Simple area preserving maps are deduced for this problem which, in some parameter regimes, appear to be good approximations of the exact solution. An attempt is then made to study the extent to which the maps can model the chaos exhibited by the particle trajectories in two dimensional moderate Reynolds number flows. The specific flow is that of a 50 percent (by volume) mixture of glycerine and water in the annulus between two concentric cylinders with the inner cylinder rotating at 125 rpm. It is found that the stretching and folding can be identified in this flow. Eddies, frequently formed as a response to the unstable gradient of angular momentum, accomplish the repeated folding of line elements. The stretching is accomplished by the action of the bulk flow around the inner cylinder. A brief computational study is conducted to assess how introducing randomness affects the chaos in area preserving maps. Dissert. Abstr.

**N88-18861** Northwestern Univ., Evanston, Ill.
**STUDIES ON HOMOGENEOUS AND HETEROGENEOUS REACTIVE FLOWS Ph.D. Thesis**
Ta-Hui David Lin 1987 246 p
Avail: Univ. Microfilms Order No. DA8723676

The theoretical and experimental studies on finite jets with and without rigid-body rotation, the investigation of the influence of vorticity on opposed-jet diffusion flames, an experimental study on flame transition in conserved systems, an asymptotic theory on spray combustion, and a theoretical analysis of the influence of radiative heat loss on flammability limits are presented. The fluid mechanics of steady, incompressible finite-jets in both rotating and nonrotating opposed-jet flow and stagnation-point flow configurations are theoretically and experimentally studied. The nature of variations of the vorticity and the rate of stretch, two aerodynamic parameters which are relevant to chemically-reactive flow fields, are discussed. In the flame transitions study, the evolution of a lean premixed flame or a rich premixed flame or both from a single initial diffusion flame are examined by systematic shifting of the reactants from one side to the other in counterflow configuration. The structure and propagation of a steady, one-dimensional, planar flame in a dilute, monodisperse spray with bulk gas-phase burning, upstream droplet vaporization and downstream droplet vaporization/combustion, is analyzed by activation energy asymptotics. Results show that the buring intensities of lean and rich sprays are respectively reduced and enhances with increasing liquid fuel loading and increasing initial droplet size. Using the matched asymptotic analysis, the structure and extinction of the one-dimensional laminar flame in the presence of radiative loss are studied. The implications of studies to the modeling of turbulent combustion spray combustion and flame radiative loss are discussed. Dissert. Abstr.

**N88-18862** Clarkson Coll. of Technology, Potsdam, N.Y.
**KINETIC AND TURBULENCE MODELS FOR GRANULAR AND TWO-PHASE FLOWS Ph.D. Thesis**
Danning Ma 1987 192 p
Avail: Univ. Microfilm Order No. DA8718361

Kinetic and turbulent models are being developed for granular and two-phase flows. A kinetic model is introduced and the kinetic equation governing the evolution of the first-order distibution function including the fluid drag force is presented. The particle-fluid interactions are analyzed and the first order particlate distribution function is determined. The system of equations governing the mean granular velocity, solid volume fraction, and fluctuation energy are developed. The special case of a simple shear flow is studied and the predictions of the present model are compared with those of other models and the available data. Turbulent flows of dispersed multiphase solid-fluid mixtures are considered. From the global equations of balance for each phase and via a special ensemble averaging technique, the local conservation laws for the mean motion are developed. The thermodynamics of the mixture in the turbulent state is studied. The concept of coldness of turbulence for each phase induced, the free energy function is discussed, and several thermodynamic relationships are established. Based on the averaged entropy inequality, constitutive equations for the stresses, energy, and heat fluxes of various species are developed. It is shown that the model contains the recently developed turbulence models for dilute two-phase flows and dense granular flows as special limiting factors. Using the turbulence model, simple shear flows of a dense solid-fluid mixture are studied. The equations governing the transport of mass, momentum, and fluctuation kinetic energy for different phases are considered. Dissert. Abstr.

**N88-18863** Alabama Univ., Huntsville.
**THEORETICAL AND EXPERIMENTAL ANALYSIS OF PRESSURE PULSE TRANSMISSION IN NON-NEWTONIAN PIPE FLOW Ph.D. Thesis**
Dezso Somogyi 1987 228 p
Avail: Univ. Microfilms Order No. DA8724344

The transmission characteristics of a pressure pulse traversing a non-Newtonian fluid flowing in a cylindrical pipe were investigated theoretically and experimentally. Specific areas studied were the transmission of discrete pulses in the laminar flow of a power law fluid. The basic differential equations governing wave phenomena in Mud Pulse Telemetry systems utilized in the drilling industry were discussed and the relative importance of the various terms evaluated. Two theoretical solution techniques were developed, a numerical method and a simplified analytical approach. Experiments were carried out to test the accuracy of the theoretical models. It was shown that the pulses used in the drilling industry fall into the linear acoustics regime. Pipe wall elasticity affects the transmission only indirectly through the sonic velocity, and is otherwise negligible in the momentum equation. The basic nonlinear stress term was linearized by the application of small perturbation theory. The three dimensional problem in x,r,t space was reduced to two dimensions by Laplace's transformation over time.
Dissert. Abstr.

**N88-18864** Columbia Univ., New York, N.Y.
**A NEW COMPUTATIONAL TECHNIQUE FOR GENERATING ALGORITHMS, WITH APPLICATION TO THE SOLUTION OF THE TIME-DEPENDENT INCOMPRESSIBLE NAVIER-STOKES EQUATIONS Ph.D. Thesis**
Robert Larkin Sullivan 1987 88 p
Avail: Univ. Microfilms Order No. DA8724106

A new technique is developed for the computer generation of numerical algorithms. The technique is employed to develop algorithms for the numerical solution of the two dimensional, time dependent incompressible Navier-Stokes equations using the velocity and pressure (u,v,p) variables. In this application the velocity components are represented by cubic polynomials in space, while the pressure is represented by a quadratic. All variables are defined at the same grid points, and boundary conditions on the flow field are directly expressible in terms of the (u,v,p) variables. Rational procedures are utilized for maintaining conservation of mass. The accuracy of the algorithms in the steady state is demonstrated for the case of a shear driven rectangular cavity. Comparison is made with an exact corner solution for the case of Stokes flow, while the results for the cases of cavity Reynolds numbers of 1, 100, 400, and 1000 are compared with the published numerical results of other investigators. The accuracy of the algorithms in the developing stages of the fluid motion is illustrated with respect to such a cavity when the slot depth is very shallow compared with its width. Dissert. Abstr.

**N88-18865** California Univ., Los Angeles.
**MIXED TURBULENT CONVECTIVE HEAT TRANSFER IN VERTICAL DUCTS Ph.D. Thesis**
Larry William Swanson 1987 232 p
Avail: Univ. Microfilms Order No. DA8723208

Time averaged and dynamic heat transfer phenomena associated with opposing mixed turbulent convection in vertical ducts were studied both experimentally and theoretically. Surface renewal theory and experimental data were used to obtain a time averaged heat transfer correlation containing the proper parameter functionality. The heat transfer dynamics of large scale flow phenomena observed were also investigated experimentally. Time series and Poincare maps were initially generated and compared with flow observations. The results indicated that although many different flow structures and flow sequences existed at the various parameter settings, the most predominant flow structure was a large single cell. All of the power spectral densities computed from the time series display broad band noise with the average power decreasing with increasing frequency. No bifurcation sequences characterizing a large scale transition mechanism could be established. Finally, the Grassberger-Proccacia dimension algorithm was implemented for data obtained at a wall heat flux of 0.4533 (Btu/sq ft/s) and a volumetric flow rate of 0.03384 (cu ft/s). Dissert. Abstr.

**N88-18866** Delaware Univ., Newark.
**TWO AND THREE DIMENSIONAL ELLIPTIC FLOWS Ph.D. Thesis**
Shih-Shan Wei 1987 166 p
Avail: Univ. Microfilm Order No. DA8725243

Two and three dimensional incompressible flows are numerically studied. The equations governing the flow and heat transfer are fully elliptic and characterized by the presence of diffusion in all directions. Time-averaged Reynolds equations along with a kappa - epsilon tubulence model are used to simulate flow turbulence. A boundary-fitted coordinate system is employed to account for the irregularity of flow domains, and the curvilinear coordinates are numerically generated by two Poisson equations, in which the inhomogeneous terms are used to control the concentration of nodal points. In the study of two-dimensional channel flows, it is found that the friction factor and the Nusselt number along the bottom of the flow cavity approach zero, and signigicantly increase at the neighborhood of reattachment points. It is also revealed that the generation of turbulence is enhanced by the existence of flow separation. In the study of flows past bluff bodies, viscous flow solutions are solved in the bounded domain in which the free-stream boundary is a stream line obtained from the potential flow solutions. The size of the recirculation zone and the Nusselt number are found to increase with the Reynolds number as long as the flow remains laminar, and then the vortex zone shrinks when the flow becomes turbulent. In the analysis of three-dimensional flows, it is shown that the vorticity-velocity formulation of the first-order upwind scheme and the third-order accuracy on the vorticity boundaries, together with the modified strongly implicit iterataion method provides stable and accurate results. Dissert. Abstr.

**N88-18867*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**NUMERICAL AND ANALYTICAL STUDY OF FLUID DYNAMIC FORCES IN SEALS AND BEARINGS**
L. T. Tam, A. J. Przekwas, A. Muszynska, R. C. Hendricks, M. J. Braun, and R. L. Mullen (Case Western Reserve Univ., Cleveland, Ohio.) Sep. 1987 38 p Presented at the 11th Biennial Design Engineering Conference on Vibration and Noise, Boston, Mass., 27-30 Sep. 1987; sponsored by ASME
(NASA-TM-100268; E-3903; NAS 1.15:100268) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical model based on a transformed, conservative form of the three dimensional Navier-Stokes equation and an analytical model based on lumped fluid parameters are presented and compared with studies of modeled rotor bearing seal systems. The rotor destabilizing factors are related to the rotative character of the flow field. It is shown that these destabilizing factors can be reduced through a decrease in the fluid average circumferential velocity. However, the rotative character of the flow field is a complex three dimensional system with bifurcated secondary flow patterns that significantly alter the fluid circumferential velocity. By transforming the Navier-Stokes equations to those for a rotating observer and using the numerical code PHOENICS-84 with a nonorthogonal body fitted grid, several numerical experiments were carried out to demonstrate the character of this complex flow field. In general, fluid injection and/or preswirl of the flow field opposing the shaft rotation significantly intensified these secondary recirculation zones and thus reduced the average circumferential velocity; injection or preswirl in the direction of rotation significantly weakened these zones. Author

**N88-18868*#** Universities Space Research Association, Huntsville, Ala. Systems Dynamics Lab.
**A VELOCITY-PRESSURE INTEGRATED, MIXED INTERPOLATION, GALERKIN FINITE ELEMENT METHOD FOR HIGH REYNOLDS NUMBER LAMINAR FLOWS Final Report**
Sang-Wook Kim Feb. 1988 96 p
(Contract NAS8-35918)
(NASA-CR-179264; NAS 1.26:179264) Avail: NTIS HC A05/MF A01 CSCL 20D

A velocity-pressure integrated, mixed interpolation, Galerkin finite element method for the Navier-Stokes equations is presented. In the method, the velocity variables were interpolated using complete quadratic shape functions and the pressure was interpolated using linear shape functions. For the two dimensional case, the pressure is defined on a triangular element which is contained inside the complete biquadratic element for velocity variables; and for the three dimensional case, the pressure is defined on a tetrahedral element which is again contained inside the complete tri-quadratic element. Thus the pressure is discontinuous across the element boundaries. Example problems considered include: a cavity flow for Reynolds number of 400 through 10,000; a laminar backward facing step flow; and a laminar flow in a square duct of strong curvature. The computational results compared favorable with those of the finite difference methods as well as experimental data available. A finite elememt computer program for incompressible, laminar flows is presented. Author

**N88-18869** New South Wales Univ., Kensington (Australia). School of Mechanical and Industrial Engineering.
**A POSTERIORI ERROR ESTIMATES IN COMPUTATIONAL FLUID MECHANICS Abstract Only. Ph.D. Thesis**
Robert James Mills Mar. 1987 282 p
Avail: Issuing Activity

A procedure is described to generate a guaranteed upper and lower bound for the discretization error in numerical solutions. This procedure is based on an existing analysis which used a complementary theory to guarantee a global upper bound for the error. However, a prerequisite of this existing analysis required the numerical solution to satisfy Green's identity a priori. The application of the complementary theory is extended to other numerical procedures by incorporating a correction to compensate for any imbalances in Green's identity. The development of this correction now renders this theory applicable to any numerical method. In addition, an extension was made to the original theory to generate a guaranteed lower bound for the discretization error by using previously established theories in functional analysis. The measure used for these bounds is the error norm, which identifies the error in the numerical solution by a single number. The theory was verified using several examples in potential theory. In addition, the versatility of the analysis was also demonstrated by it successful application to three different numerical techniques. The theory was extended to solutions obtained on nonuniform grids and tested using several examples in this application. The results obtained prove that these bounds do exist and that they converge onto the exact solution monotonically as the mesh is refined, once the solution is within the asymptotic range. Author

**N88-18870*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**UNSTEADY HEAT TRANSFER IN TURBINE BLADE DUCTS: FOCUS ON COMBUSTOR SOURCES**
Kenneth J. Baumeister and Ronald Huff (Huff and Associates, Cleveland, Ohio.) [1988] 18 p Prepared for presentation at the National Heat Transfer Conference, Houston, Tex., 24-27 Jul. 1988; sponsored by ASME
(NASA-TM-100815; E-4000; NAS 1.15:100815) Avail: NTIS HC A03/MF A01 CSCL 20D

Thermal waves generated by either turbine rotor blades cutting through nonuniform combustor temperature fields or unsteady burning could lead to thermal fatigue cracking in the blades. To determine the magnitude of the thermal oscillation in blades with complex shapes and material compositions, a finite element Galerkin formulation has been developed to study combustor generated thermal wave propagation in a model two-dimensional duct with a uniform plug flow profile. The reflection and transmission of the thermal waves at the entrance and exit boundaries are determined by coupling the finite element solutions at the entrance and exit to the eigenfunctions of an infinitely long adiabatic duct. Example solutions are presented. In general, thermal wave propagation from an air passage into a metallic blade wall is small and not a problem. However, if a thermal barrier coating is applied to a metallic surface under conditions of a high heat transfer, a good impedance match is obtained and a significant portion of the thermal wave can pass into the blade material. Author

**N88-18871*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THERMOSOLUTAL CONVECTION IN HIGH-ASPECT-RATIO ENCLOSURES**
L. W. Wang and C. T. Chen (National Cheng Kung Univ., Tainan, Taiwan ) [1988] 14 p Prepared for presentation at the 25th National Heat Transfer Conference, Houston, Tex., 24-27 Jul. 1988; sponsored by the ASME
(NASA-TM-100803; E-3881; NAS 1.15:100803) Avail: NTIS HC A03/MF A01 CSCL 20D

Convection in high-aspect-ratio rectangular enclosures with combined horizontal temperature and concentration gradients is studied experimentally. An electrochemical system is employed to impose the concentration gradients. The solutal buoyancy force either opposes or augments the thermal buoyancy force. Due to a large difference between the thermal and solutal diffusion rates the flow possesses double-diffusive characteristics. Various complex flow patterns are observed with different experimental conditions. Author

**N88-18872#** Maryland Univ., College Park. Dept. of Mechanical Engineering.
**MEASUREMENT OF VELOCITY AND TEMPERATURE PROFILES IN LOW-SPEED, TURBULENT NON-ISOTHERMAL FLOWS**
V. Motevalli, C. H. Marks, and B. J. McCaffrey Nov. 1987 27 p Sponsored by National Bureau of Standards, Gaithersburg, Md. Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville
(PB88-155833; NBS/GCR-87/535) Avail: NTIS HC A03/MF A01 CSCL 20D

A probe was developed utilizing thermocouples as the sensors which, together with associated data reduction and processing equipment, makes it possible to measure velocity and temperature profiles in low-speed, turbulent, nonisothermal flows. The technique presented might be well suited for transient processes where simultaneous measurements are required in multiple locations. The probe was devised in order to measure the velocity and temperature profiles in the jet formed under a ceiling when a buoyant plume from a fire impinges on the ceiling. GRA

**N88-18873#** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**PHYSICS OF IMMISCIBLE FLOW IN POROUS MEDIA Final Report, Oct. 1984 - Oct. 1987**
J. C. Parker, R. J. Lenhard, and T. Kuppusamy Nov. 1987 149 p Sponsored by EPA, Ada, Okla.
(PB88-131008; EPA-600/2-87/101) Avail: NTIS HC A07/MF A01 CSCL 20D

Conceptual formulation, numerical implementation and experimental validation of a model for the movement of organic chemicals which are introduced into soils as nonaqueous phase liquids via surface spills or leakage from subsurface containment facilities were addressed. Relationships between fluid pressures (P), saturation (S) and permeabilities (k) were developed. Relative permeability-saturation relations are predicted from the scaled S-P function, which is assumed to reflect the pore size distribution of the medium. Procedures were developed for the direct measurement of fluid pressures and saturations in three phase systems. Validation studies indicated the k-S-P model provides a reasonable description of the system behavior under the imposed experimental conditions and may be satisfactorily calibrated using relatively simple procedures. Author

**N88-18874#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
**SUSPENSION OF SMALL METALLIC PLATES: A VERSATILE SENSOR**
M. Stalder and W. Luethy 5 May 1986 24 p
(PB88-130901; MM:1985/86-LY-11) Avail: NTIS HC A03/MF A01 CSCL 20D

Small metallic plates suspended in a liquid are a good medium to generate visible velocity gradients in the convection flow. They tend to align parallel to the flow and lead to anisotropic optical properties of the fluid. Besides Benard and Rayleigh instabilities that can be seen upon heating or cooling of the liquid layer, presented is a new type of fluid convection instability based on segregation of the suspension. It is demonstrated that the suspension can be used as a sensitive infrared image converter. Electric and magnetic fields can interact with the metal plates and lead to similar optical anisotropics without heating of the suspension. It is shown that this allows the construction of displays that can be operated with typically 20 Volts applied on a suspension layer of 1 mm thickness. Author

**N88-18875*#** Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
**TOPOLOGY AND GRID ADAPTION FOR HIGH-SPEED FLOW COMPUTATIONS Final Report, 1 Jan. - 31 Dec. 1987**
Surendra N. Tiwari and Jamshid S. Abolhassani Jan. 1988 146 p
(Contract NCC1-68)
(NASA-CR-182586; NAS 1.26:182586) Avail: NTIS HC A07/MF A01 CSCL 20D

The effects of grid topology and grid adaption on numerical solutions of the Navier-Stokes equations are investigated. A general procedure is presented for computation of high-speed flow over complex three-dimensional configurations. The flow field is simulated on the surface of a Butler wing in a uniform stream. Results are presented for Mach 3.5 and a Reynolds number of 2,000,000. Results demonstrate that while an H-type grid is suitable for the leading and trailing edges, a more accurate solution can be obtained for the middle part of the wing with an O-type grid. Methods of grid adaption are reviewed and a method is developed with the capability of adapting to several variables. This method is based on a variational approach and is algebraic. The method has been formulated in such a way that there is no need for matrix inversion. A movie has been produced which shows simultaneously the transient behavior of the solution and the grid adaption. For both cases, the simulations are done by integrating the viscous Navier-Stokes equations. Results indicate the viability and validity of the proposed methods. Author

**N88-18876#** Case Western Reserve Univ., Cleveland, Ohio.
**LASER VELOCIMETER MEASUREMENTS OF SOLIDS IN MULTIPHASE FLOW Quarterly Technical Progress Report, 1 Jun. - 31 Aug. 1987**
J. R. Kadambi 1987 9 p
(Contract DE-FG22-86PC-90961)
(DE88-000196; DOE/PC-90961/T4) Avail: NTIS HC A02/MF A01

Preliminary experiments were conducted to obtain pressure drop data for the slurry containing silica gel. Based on this data, a Refractive Index Multiphase Flow Test Loop (RIMMTL) was designed. The details are provided. DOE

**N88-18877#** Sandia National Labs., Albuquerque, N. Mex.
**EFFECT OF EXPERIMENTAL VARIABLES ON FLASH THERMAL DIFFUSIVITY DATA ANALYSIS**
J. N. Sweet Oct. 1987 18 p Presented at the 29th International Thermal Conductivity Conference, Blacksburg, Va., 19 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003631; SAND-87-1392C; CONF-8710249-1) Avail: NTIS HC A03/MF A01

Flash thermal diffusivity data are usually analyzed with a thermal model which assumes axial heat conduction and uniform illumination of the flashed surface. For high accuracy data reduction, it becomes important to bound to the errors caused by radial heat flow and by non-uniform laser beam profiles. These effects are examined analytically for a case in which the incident laser beam is confined to a radius smaller than the sample radius. The dependence of the output of an averaging detector on the magnitude of the radial heat transfer coefficient is presented and the linear dependence of radial and axial loss sensitivity coefficients is discussed. From this discussion, we conclude that inclusion of radial loss effects in analysis of the thermal response of multilayer structures is not important unless the radial loss factor is very large. Analytical results are presented for the temperature vs. time response of a two layer composite sample with interfacial thermal resistance and high thermal losses at the sample faces. The use of these results to reduce data for two multilayer samples is presented to show the utility of new data reduction techniques. DOE

**N88-18878#** Sandia National Labs., Albuquerque, N. Mex.
**EFFECT OF DENSITY CHANGE ON RAPID LIQUID-SOLID INTERFACE KINETICS AND HEAT FLOW**
P. M. Richards 1987 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-004286; SAND-87-1362C; CONF-871124-50) Avail: NTIS HC A02/MF A01

Consequences of the need to transport density to or from a fast-moving liquid-solid interface are examined. There can be a severe limitation of the freezing velocity and a change in the amount of heat which must be conducted. The latter effect produces a net latent heat which can be significantly different from the equilibrium value and even change sign. DOE

**N88-18879#** Illinois Univ., Urbana.
**A LECTURE ON DETONATION-SHOCK DYNAMICS**
D. S. Stewart and J. B. Bdzil 1987 20 p Presented at the US/Japan Workshop on Combustion, Juneau, Alaska, 1 Aug. 1987 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE88-004313; LA-UR-87-4077; CONF-8708205-1) Avail: NTIS HC A03/MF A01

Recent investigations into the theory of multi-dimensional, time-dependent detonation are summarized. These advances have led to the development of a theory for describing the propagation of high-order detonation in condensed-phase explosives. The central approximation in the theory is that the detonation shock is weakly curved. Specifically, it is assumed that the radius of curvature of the detonation shock is large compared to a relevant reaction-zone thickness. The main findings are: (1) the flow is

quasi-steady and nearly one dimensional along the normal to the detonation shock; and (2) the small deviation of the normal detonation velocity from the Chapman-Jouguet (CJ) value is generally a function of curvature. The exact functional form of the correction depends on the equation of state (EOS) and the form of the energy-release law. DOE

**N88-18880*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**TURBULENCE MODELING IN NON-INERTIAL FRAMES OF REFERENCE Final Report**
Charles G. Speziale Mar. 1988 52 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181646; ICASE-88-18; NAS 1.26:181646) Avail: NTIS HC A04/MF A01 CSCL 20D

The effect of an arbitrary change of frame on the structure of turbulence models is examined from a fundamental theoretical standpoint. It is proven, as a rigorous consequence of the Navier-Stokes equations, that turbulence models must be form invariant under arbitrary translational accelerations of the reference frame and should only be affected by rotations through the intrinsic mean vorticity. A direct application of the invariance property along with the Taylor-Proudman Theorem, material frame-indifference in the limit of two-dimensional turbulence and Rapid Distortion Theory is shown to yield powerful constraints on the allowable form of turbulence models. Most of the commonly used turbulence models are demonstrated to be in serious violation of these constraints and consequently are inconsistent with the Navier-Stokes equations in non-inertial frames. Alternative models with improved non-inertial properties are developed and some simple applications to rotating turbulent flows are considered. Author

**N88-18881*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
**INFLUENCE OF BASE MODIFICATIONS ON IN-FLIGHT BASE DRAG IN THE PRESENCE OF JET EXHAUST FOR MACH NUMBERS FROM 0.7 TO 1.5**
Sheryll Goecke Powers Feb. 1988 20 p
(NASA-TP-2802; H-1408; NAS 1.60:2802) Avail: NTIS HC A03/MF A01 CSCL 20D

The use of external modifications in the base region to reduce the base drag of a blunt-base body in the presence of jet engine exhaust was investigated in flight. Base pressure data were obtained for the following configurations: (1) blunt base; (2) blunt base modified with splitter plate; and (3) blunt base modified with two variations of a vented cavity. Reynolds number based on the length of the aircraft ranged from 1.2 to 3.1 x 10 to the 8th. Mach number M ranges were 0.71 less than or = M less than or = 0.95 and 1.10 less than or = M less than or = 1.51. The data were analyzed using the blunt base for a reference, or baseline condition. For 1.10 less than or = M less than or = 1.51, the reduction in base drag coefficient provided by the vented cavity configuration ranged from 0.07 to 0.05. These increments in base drag coefficient at M = 1.31 and 1.51 result in base drag reductions of 27 and 24 percent, respectively, when compared to the blunt base drag. For M less than 1, the drag increment between the blunt base and the modification is not significant. Author

**N88-18882#** Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
**LAVAL NOZZLE FLOW OF A BINARY, RETROGRADE MIXTURE Thesis [LAVALDUESENSTROEMUNG EINES BINAEREN, RETROGRADEN GEMENGES]**
Hermann Tacke Feb. 1987 68 p In GERMAN
(MPIS-1/1987; ISSN-0936-1199; ETN-88-91042) Avail: NTIS HC A04/MF A01

The flow in a convergent free-jet nozzle was investigated in order to determine the effect of mixtures of substances on flow and evaporation phenomena. Laval nozzle flow with a binary, retrograde mixture was realized in a blowdown experiment. The results show that complete adiabatic evaporation is possible in a transonic nozzle flow. For pure substances in two-phase mixtures thermodynamic equilibrium is reached, and separation phenomena occur during the evaporation. A quasi stationary phase develops due to an inhomogeneous density distribution and the concomitant anisentropic expansion in the reservoir. The mass flow density in the narrowest cross section increases monotonically with temperature. The estimated flow velocity in the narrowest cross section does not significantly deviate from the equilibrium sound velocity. ESA

**N88-18883*#** Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
**TRANSIENT RADIATIVE ENERGY TRANSFER IN INCOMPRESSIBLE LAMINAR FLOWS Progress Report, period ending 30 Jun. 1987**
S. N. Tiwari and D. J. Singh Jun. 1987 285 p
(Grant NAG1-423)
(NASA-CR-182605; NAS 1.26:182605) Avail: NTIS HC A13/MF A01 CSCL 20D

Analysis and numerical procedures are presented to investigate the transient radiative interactions of nongray absorbing-emitting species in laminar fully-developed flows between two parallel plates. The particular species considered are OH, CO, CO2, and H2O and different mixtures of these. Transient and steady-state results are obtained for the temperaure distribution and bulk temperature for different plate spacings, wall temperatures, and pressures. Results, in general, indicate that the rate of radiative heating can be quite high during earlier times. This information is useful in designing thermal protection systems for transient operations. Author

**N88-18884*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**GALILEO PROBE PARACHUTE TEST PROGRAM: WAKE PROPERTIES OF THE GALILEO PROBE AT MACH NUMBERS FROM 0.25 TO 0.95**
Thomas N. Canning (Canning, T. N., Portola Valley, Calif ) and Thomas M. Edwards Apr. 1988 144 p
(Contract NAS2-10000)
(NASA-RP-1130; A-9643; NAS 1.61:1130) Avail: NTIS HC A07/MF A01 CSCL 20D

The results of surveys of the near and far wake of the Galileo Probe are presented for Mach numbers from 0.25 tp 0.95. The trends in the data resulting from changes in Mach number, radial and axial distance, angle of attack, and a small change in model shape are shown in crossplots based on the data. A rationale for selecting an operating volume suitable for parachute inflation based on low Mach number flight results is outlined. Author

**N88-18885#** AiResearch Mfg. Co., Torrance, Calif.
**OPEN-CYCLE CENTRIFUGAL VAPOR-COMPRESSION HEAT PUMP Final Report, Jan. 1986 - May 1987**
L. R. Burgmeier and J. E. Horner 30 Nov. 1987 33 p
(Contract GRI-5082-233-0745)
(PB88-157391; DOC-87-60964; GRI-87/0345) Avail: NTIS HC A03/MF A01 CSCL 20D

The objectives of the program were: (1) to develop an open cycle, high lift, centrifugal steam compressor system that can be efficiently retrofitted to existing multi-effect and high temperature differential evaporators while maintaining the cost benefits of a single stage centrifugal compressor, and (2) to demonstrate the energy saving cost benefits of driving the compressor with a natural gas fueled gas turbine engine. The turbine exhaust was to be used for final drying of the product that was evaporated. The installation of the system is described along with the test activities through May 1987. Author

**N88-19188** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**A GENERALISATION OF HALL'S SCHEME FOR SOLVING THE EULER EQUATIONS FOR TWO-DIMENSIONAL FLOWS**
M. T. Arthur *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 7-23 (For primary document see

N88-19187 11-64)
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**N88-19191** Ruhr Univ., Bochum (West Germany). Inst. fuer Thermo- und Fluiddynamik.
**IMPLEMENTATION OF MULTIGRID IN SOLA ALGORITHM**
U. Brockmeier, N. K. Mitra, and M. Fiebig *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 49-61 (For primary document see N88-19187 11-64)
Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

**N88-19194** Manchester Univ. (England). Dept. of Mathematics.
**SOLUTION OF A ROTATING NAVIER-STOKES PROBLEM BY A NONLINEAR MULTIGRID ALGORITHM**
F. Lonsdale *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 95-109 (For primary document see N88-19187 11-64)
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**N88-19196** Bristol Univ. (England). Dept. of Computer Science.
**APPLICATION OF THE MULTIGRID TECHNIQUE TO THE PRESSURE-CORRECTION EQUATION FOR THE SIMPLE ALGORITHM**
V. Pau and E. Lewis *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 121-142 (For primary document see N88-19187 11-64)
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**N88-19201** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**APPLICATIONS OF A MULTIGRID FINITE VOLUME METHOD WITH RUNGE-KUTTA TIME INTEGRATIONS FOR SOLVING THE EULER AND NAVIER-STOKES EQUATIONS**
B. Wagner, B. Leicher, and W. Schmidt *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 207-215 (For primary document see N88-19187 11-64)
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# 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

**N88-18886#** National Aerospace Lab., Tokyo (Japan).
**ERROR EVALUATION OF SOME PRACTICAL THERMOCOUPLE PROBES FOR GAS TURBINE COMBUSTOR TESTS**
Takashi Tamaru and Kazuo Shimodaira Jul. 1987 24 p In JAPANESE; ENGLISH summary
(NAL-TR-938; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Recent high temperature rise combustor research requires very reliable temperature measurement at the exit plane of the combustor. Error evaluation was made here for some practical thermocouple rakes which suffer conductive and radiative effects simultaneously. One of the rakes was especially fabricated from platinum sheathed thermocouples to cope with high temperature and humid environments. The probes were tested in a water cooled duct while passing a hot burning gas through the duct. The error analysis shows that a nondimensional parameter based on the temperature difference between the gas and the wall describes the error magnitude well. The increased Reynolds number of the main flow decreases the error but the wall radiation deviates the value by the third power of the main stream temperature. Author

**N88-18887#** Sandia National Labs., Albuquerque, N. Mex.
**ACOUSTIC WAVE ELECTROLESS DEPOSITION MONITOR**
A. J. Ricco and S. J. Martin 1987 11 p Presented at the 172nd Meeting of the Electrochemical Society, Honolulu, Hawaii, 18 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE88-004023; SAND-87-1095C; CONF-871027-43) Avail: NTIS HC A03/MF A01

A new type of electroless deposition monitor has been constructed from a monolithic acoustic wave device utilizing plate modes with shear displacement components. This device, which operates at 158 MHz, provides a highly accurate means of measuring mass changes (1 ng sq cm) accompanying electrochemical reactions. The acoustic wave, in the form of a plate mode, is launched by applying a radio frequency signal to an interdigital transducer on one face of a piezoelectric substrate. Electroless deposition is carried out on the opposite face of the quartz in the path of the wave. The acoustic plate mode, which propagates along the quartz plate to the receiving transducer, has components of displacement at the surface/electrolyte interface. Changes in mass at the quartz/electrolyte interface affect the acoustic wave velocity, which is monitored with high accuracy by utilizing the device as the feedback element of an oscillator circuit. The electroless deposition of Cu at a rate of 2 to 3 angstons per second from aqueous Cu (2+) formaldehyde was monitored with sub-angstrom resolution. DOE

**N88-18888#** Rockwell International Corp., Golden, Colo.
**CALIBRATION OF A HARWOOD DWT-1000 CONTROLLED-CLEARANCE PISTON GAUGE**
D. I. Shain, ed. and C. A. Deitesfeld, ed. 30 Sep. 1987 14 p
(Contract DE-AC04-76DP-03533)
(DE88-004496; RFP-4132) Avail: NTIS HC A03/MF A01

To meet growing demands for higher pressure measurements and measurement accuracies up to 200,000 psig, the Physical Metrology Laboratory (PML) at Rocky Flats Plant, Golden, Colorado, purchased and calibrated a Harwood Model DWT-1000, controlled-clearance piston gauge. Calibration of the DWT-1000 followed guidelines established by the National Bureau of Standards (NBS). The pressure medium used during operation and calibration of the system was n-Heptane. Due to the flammability of n-Heptane, safety enclosure was designed and constructed around the DWT-1000 which, when used in conjunction with a data acquisition console, monitors both safety and calibration equipment while protecting the surrounding environment in the event of a sudden pressure release. Calibration results and procedures are compiled in this report to assist those who will be or are presently confronted with the challenge of calibrating a similar type controlled-clearance piston gauge. DOE

**N88-18889#** Rockwell International Corp., Golden, Colo.
**ELECTROMECHANICAL TIMING MEASUREMENT TECHNIQUE**
N. C. Kortekaas, ed. and R. L. Thomas, ed. Oct. 1987 25 p
(Contract DE-AC04-76DP-03533)
(DE88-005098; RFP-4116) Avail: NTIS HC A03/MF A01

In industry, the performance of the electromechanical device is gauged by its timing characteristics. Necessary in situ time interval measurements are impossible because counters require triggering events, which are absent during device operation and impractical because the mechanical structure of the device cannot be readily changed to accommodate such measurements. A method is introduced for determining the device timing characteristics by measuring and sampling the response current or voltage under static and dynamic conditions during the effective periods the device is operated. A theoretical model is presented to explain electromechanical behavior and the timing characteristics; it also provides a format for a software routine,

which computes the timing characteristics from the measurement data. DOE

**N88-18890#** Stuttgart Univ. (West Germany). Fakultaet fuer Physik.

**DETERMINATION OF THE EQUILIBRIUM CONCENTRATION OF CHARACTERISTIC DEFECTS BY THE MEASUREMENT OF THERMAL EXPANSION USING NEUTRON SCATTERING AND LASER INTERFEROMETRY Ph.D. Thesis [BESTIMMUNG DER GLEICHGEWICHTSKONZENTRATION VON EIGENFEHLSTELLEN DURCH MESSUNG DER THERMISCHEN AUSDEHNUNG MITTELS NEUTRONENSTREUUNG UND LASERINTERFEROMETRIE]**

Wolfgang Trost 1986 67 p In GERMAN Sponsored by BMFT

(ETN-88-91489) Avail: NTIS HC A04/MF A01

A measurement apparatus using neutron scattering and laser interferometry was developed on a high flux reactor in order to improve the accuracy in the determination of the concentration of atomic defects. The theoretical fundamentals of atomic defects and their correlation with thermal expansion are described. The theoretical description of the measurement of the macroscopic and microscopic thermal expansion, and the estimation of the accuracy are given. The combination of neutron scattering and laser interferometry provides a more than tenfold better accuracy and a substantial widening of the measurement domain up to temperatures of 200 K, as compared to the presently used methods. ESA

**N88-18891** Politecnico di Milano (Italy). Dipt. di Elettronica.

**A MICROSPECTROFLUOROMETER SYSTEM BASED ON REAL TIME DIGITAL TECHNIQUES**

A. Longoni, S. Cova, P. Giordano (Consiglio Nazionale delle Ricerche, Pavia, Italy ), and I. Freitas 1986 62 p Sponsored by CNR and the Italian Ministry of Public Education

(Rept-86-014; ETN-88-91650) Avail: Issuing Activity

A microspectrofluorometer apparatus for histochemical and cytochemical studies is presented. It is a flexible, open-ended system, capable of incorporating further development without extensive rearrangements, and employing as building blocks standard laboratory instruments (e.g., optical spectrograph; multichannel pulse analyzer). The design philosophy and the measurement techniques include single-photon detection; real time digital lock-in detection; digital wavelength control and modulation; and digital averaging of fast, repetitive wavelength scans with up-up or up-down scanning modes. The layout of the system and the logic design of its automation control are described. Measurements at very low fluorescence intensity levels in presence of high background; on-line minimization of the photofading effects on the measured spectrum shape; and real time digital modulation derivative spectroscopy are discussed. ESA

**N88-18892*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**PROTOTYPE THIN-FILM THERMOCOUPLE/HEAT-FLUX SENSOR FOR A CERAMIC-INSULATED DIESEL ENGINE Final Report**

Walter S. Kim and Richard F. Barrows Mar. 1988 16 p

(Contract DE-AI01-86CE-50162)

(NASA-TM-100798; E-3976; DOE/NASA/50162-1; NAS 1.15:100798) Avail: NTIS HC A03/MF A01 CSCL 14B

A platinum versus platinum-13 percent rhodium thin-film thermocouple/heat-flux sensor was devised and tested in the harsh, high-temperature environment of a ceramic-insulated, low-heat-rejection diesel engine. The sensor probe assembly was developed to provide experimental validation of heat transfer and thermal analysis methodologies applicable to the insulated diesel engine concept. The thin-film thermocouple configuration was chosen to approximate an uninterrupted chamber surface and provide a 1-D heat-flux path through the probe body. The engine test was conducted by Purdue University for Integral Technologies, Inc., under a DOE-funded contract managed by NASA Lewis Research Center. The thin-film sensor performed reliably during 6 to 10 hr of repeated engine runs at indicated mean surface temperatures up to 950 K. However, the sensor suffered partial loss of adhesion in the thin-film thermocouple junction area following maximum cyclic temperature excursions to greater than 1150 K. Author

**N88-18893#** National Bureau of Standards, Gaithersburg, Md. Polymers Div.

**PREPARATION OF THIN FILM POLYVINYLIDENE FLUORIDE SHOCK WAVE PRESSURE TRANSDUCERS Annual Report**

A. J. Bur and S. C. Roth Dec. 1987 24 p Sponsored by Naval Surface Weapons Center, Silver Spring, Md.

(PB88-156070; NBSIR-87/3680) Avail: NTIS HC A03/MF A01 CSCL 14B

Thin film polyvinylidene fluoride transducers were prepared by a poling procedure which involves the repeated cycling of the applied electric field over the ferroelectric hysteresis curve. Using the procedure, it is possible to prepare a uniformly poled transducer and to establish, with precision, the final remnant polarization. The remnant or permanent polarization is calculated by measuring the total poling charge and subtracting from it that which arises from the resistance and capacitance of the specimen. By this method ten gages were prepared with the same remnant polarization with a precision of 0.5 percent. The X-ray observations and measurements of density on an unpoled specimen show that the film is biaxially oriented, contains both alpha and beta phase crystals, and is 50 percent crystalline. GRA

**N88-18894#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.

**RECORDING A SURFACE ACOUSTIC WAVE ON THE SURFACE OF SILICON**

D. Jost, W. Luethy, and H. P. Weber 12 Jun. 1986 9 p

(PB88-130372; MM:1985/86-LY-17) Avail: NTIS HC A02/MF A01 CSCL 14E

A new type of surface ripples on the surface of single crystalline Silicon were generated by scanned irradiation with picosecond laser pulses. It is postulated that these ripples represent a frozen out surface acoustic wave. Author

**N88-18895#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.

**NEW MONOSTATIC BALANCED DOPPLER VELOCIMETER USING A POLARIZATION PRESERVING FIBER**

R. Baettig, R. Stierlin, P. D. Henchoz, and H. P. Weber 7 Oct. 1986 24 p

(PB88-130869; MM:1986/87-WB-7) Avail: NTIS HC A03/MF A01 CSCL 14B

A new fiberoptic Doppler velocimeter is presented. By suitably controlling the polarization of a local oscillator, illuminating beam and signal light, balanced mixing with a noise reduction of 30 dB as compared to unbalanced mixing can be realized. The remaining noise level is predominantly due to shot noise. Allowing for losses in the receiving optics and non perfect mixing efficiency the minimum detectable signal power is estimated to be 10 to the -18th power WHz(-1). The high sensitivity of the system is demonstrated by the detection of light scattered from a distant moving object. Author

**N88-18896#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**REACTION WHEEL EXPERIMENTAL MODEL OF ARTIFICIAL SATELLITE ATTITUDE CONTROL: CONSTRUCTION, SIMULATION, AND TESTS [MODELO EXPERIMENTAL DE UMA RODA DE REACAO PARA CONTROLE DA ATITUDE DE SATELITES ARTIFICIAIS: CONSTRUCAO, SIMULACAO E TESTES]**

Petronio NoronhadeSouza and Agenor deToledoFleury Aug. 1987 6 p In PORTUGUESE; ENGLISH summary Presented at the 9th Brazilian Congress of Mechanical Engineering-COBEM/87, Florianopolis, Santa Catarina, 7-11 Dec.

(INPE-4274-PRE/1146) Avail: NTIS HC A02/MF A01

This work describes aspects of design, construction, simulation and tests of a low capacity reaction wheel experimental model. Computer simulations are presented using a nonlinear algorithm in order to represent the critical problem that occurs when the wheel speed has to cross near-zero velocities, where dry and stiction frictions cause a large degradation of actuator performance. After measurement of the friction paramaters, simulations were done in laboratory using a model including a new speed control system. The experimental results are compared with the computer simulations demonstrating a good coherence. Author

**N88-18897#** Messerschmitt-Boelkow-Blohm G.m.b.H., Schrobenhausen (West Germany). Unternehmensbereich Apparate.

**SPLINTER GENERATOR [SPLITTERGENERATOR]**

Manfred Held 1987 90 p In GERMAN

(MBB-UA-1048/87; ETN-88-91381) Avail: NTIS HC A05/MF A01

A splinter generator was designed, built and tested for the study of the synergistic effects in shooting at target structures with splinter-effect ammunition. The design of the generator and the test stand are described. Due to the possibility to correlate the positions of the hit encounters on the target plate, the angle of jump in elevation and azimuthal direction and hence the real paths between the detonation of the bursting charge and the X-ray flash pictures could be determined. This allows a precise determination of the velocities of the single splinters. In spite of the large scattering of the splinter penetration depths in the soft-iron target plate, a correlation between impact speed and working depth was deduced. ESA

**N88-18898#** Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).

**THE LIGHT PULSE GENERATOR 869 FOR HIGH SPEED INVESTIGATIONS [DER LICHTIMPULSGENERATOR 869 FUER HOCHGESCHWINDIGKEITS-UNTERSUCHUNGEN]**

B. Stasicki, W. J. Hiller, and G. E. A. Meier Jun. 1987 60 p In GERMAN

(MPIS-9/1987; ISSN-0436-1199; ETN-88-91434) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany DM 27

A high speed light pulser was developed for spectral studies as well as for the photographic recording of fast periodic and nonperiodic phenomena. The model 869 is described and compared with the high frequency stroboscope (model 839). The technical data of control unit and flash lights are given. The block diagram and the operation of the apparatus are explained including inputs and outputs, operation and indication elements, and balancing elements. The loading capacity of the flash diodes is discussed. Experiments with the apparatus, as well as applications are outlined. ESA

**N88-18899#** Tuebingen Univ. (West Germany). Fakultaet fuer Physik.

**CONCEPTION AND REALIZATION OF COMPONENTS FOR A MICROCHANNEL-PLATE DETECTOR, AND TESTING OF THE DETECTOR SYSTEM IN THE LABORATORY AND IN ASTRONOMICAL USE Ph.D. Thesis [KONZEPTION UND REALISIERUNG VON KOMPONENTEN EINES MIKROKANALPLATTEN-DETEKTORS UND TEST DES DETEKTORSYSTEMS IM LABOR UND IM ASTRONOMISCHEN EINSATZ]**

Martin Gutekunst 1987 131 p In GERMAN

(ETN-88-91495) Avail: NTIS HC A07/MF A01

A two-dimensionnal photon counting detector system was developed. A multistep production process for the conducting strip anode was developed to meet the requirements concerning the relative accuracy of the determination of the location where phenomena occur. A multiplexer card was developed to substantially shorten data transfer time between evaluation electronics and computer. Laboratory tests show that the resolution is not limited by the microchannel plate tubes, but by the evaluation electronics. Recordings with polarization filters show that the obtained accuracy of the determination of the linear polarization using microchannel plate detectors is comparable with other methods. Narrow band recordings of the planetary nebula NGL40 demonstrate the possibility to analyze a class of planetary nebulae with relatively low excited envelope and very hot central star. ESA

**N88-18900*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**DESCRIPTION OF MSFC ENGINEERING PHOTOGRAPHIC ANALYSIS**

Jim Earle and Frank Williams (Rockwell International Corp., Huntsville, Ala.) Mar. 1988 26 p

(NASA-TM-4035; NAS 1.15:4035) Avail: NTIS HC A03/MF A01 CSCL 14E

Utilizing a background that includes development of basic launch and test photographic coverage and analysis procedures, the MSFC Photographic Evaluation Group has built a body of experience that enables it to effectively satisfy MSFC's engineering photographic analysis needs. Combining the basic soundness of reliable, proven techniques of the past with the newer technical advances of computers and computer-related devices, the MSFC Photo Evaluation Group is in a position to continue to provide photo and video analysis service center-wide and NASA-wide to supply an improving photo analysis product to meet the photo evaluation needs of the future; and to provide new standards in the state-of-the-art of photo analysis of dynamic events. Author

**N88-18785*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**PHASE CALIBRATION GENERATOR**

E. H. Sigman *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 89-104 (For primary document see N88-18774 11-32)

Avail: NTIS HC A10/MF A01 CSCL 14B

# 36 LASERS AND MASERS

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

**N88-18901*#** Oklahoma State Univ., Stillwater. Dept. of Physics.

**GROWTH AND CHARACTERISTICS OF MATERIALS FOR TUNABLE LASERS IN THE NEAR INFRARED SPECTRAL REGION Semiannual Progress Report, 1 Aug. 1987 - 31 Jan. 1988**

Richard C. Powell and Joel J. Martin 1988 20 p

(Grant NAG1-694)

(NASA-CR-182501; NAS 1.26:182501) Avail: NTIS HC A03/MF A01 CSCL 20E

A method for growing crystals of LiYF4 using an HF pretreatment and purification system is described. In addition, spectrum analyses were performed on eight crystals of type LiNbO3:Mg,Cr,RE, which were grown in order to investigate the use of lithium niobate as a laser host material. J.P.B.

**N88-18902#** Stanford Univ., Calif. Lab. of Physics.

**DIODE PUMPED FIBER LASER Final Report, Sep. 1984 - Dec. 1986**

A. C. Cordova-Plaza, M. J. Digonnet, K. A. Fesler, C. J. Gaeta, and S. Ping Aug. 1987 226 p

(Contract F33615-82-C-1749)

(AD-A187694; AFWAL-TR-87-1084) Avail: NTIS HC A11/MF A01 CSCL 09C

Q-switching in Nd:YAG fibers was investigated as a particularly interesting technique to generate narrow pulses in miniature solid state lasers. Laboratory models of both mechanically and passively Q-switched Nd:YAG fiber lasers were developed and characterized. The devices were made of a short length of end polished fiber placed between two miniature laser mirrors and optically end-pumped with a dye laser. Mechanical Q-switching, achieved

by modulating the orientation of one of the mirrors, led to the generation of pulse trains with 50 mW peak power and 70 nsec wide individual pulses. The pulse train structure was explained by the slow nature of the switching mechanism, and quantitatively predicted by a novel slow Q-switching theoretical model. Passive Q-switching was realized in practice by placing a thin film of saturable absorber in the fiber laser cavity, thereby preserving the miniature character of the device. A record pulse width of 6 nsec and peak power of 2 watts were observed in state-of-the-art, Nd:YAG waveguiding fibers, which is the first report of nonsecond pulse generation in single crystal fibers. GRA

**N88-18903#** Chemical Research and Development Center, Aberdeen Proving Ground, Md.
**DEPOLARIZED INFRARED REFLECTANCE FROM DRY AND WETTED SURFACES Technical Report, Dec. 1985 - Nov. 1986**
Arthur H. Carrieri, John T. Ditillo, and Mark S. Schlein Sep. 1987 23 p
(AD-A188213; CREDC-TR-87084) Avail: NTIS HC A03/MF A01 CSCL 20F

Backscattering of the carbon dioxide laser was measured from soil, sand, concrete, asphalt, and military-specified painted metal plates before and after contamination by an infrared-absorbing liquid. Sensitivity of the 9- to 11-micron volume reflectance spectra to the targeted liquid contamination differed significantly between porous and nonporous scattering surfaces, indicating that diffusion of liquid into the material bulk, not resonant absorption of the probe laser by the liquid, dictates direct detection sensitivity thresholds. GRA

**N88-18904#** Sandia National Labs., Albuquerque, N. Mex.
**POLARIZATION EFFECTS IN LASER-PUMPED Nd:YAG LASERS**
P. Esherick and A. Owyoung 1988 5 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004019; SAND-87-3071C; CONF-880110-6) Avail: NTIS HC A02/MF A01

Our investigations into the polarization properties of mechanically-stressed monolithic Nd:YAG oscillators have led to two important discoveries. First is the applicability of mechanical stress as a means for rapidly tuning the output frequency of a single-mode monolithic oscillator. The second, quite unexpected, discovery is that the polarization emitted by such a Nd:YAG oscillator is strongly dependent on both the polarization and precise wavelength of the (nominally 800 nm wavelength) pump radiation. DOE

**N88-18905#** XMR, Inc., Santa Clara, Calif.
**BURST MODE Nd:YLF LASER OSCILLATOR Final Monthly Progress Report No. 8**
S. Kimberland Mar. 1987 11 p
(Contract W-7405-eng-48)
(DE88-004040; UCRL-15923) Avail: NTIS HC A03/MF A01

This report discusses the costs, status of equipment and limited performance of the burst mode Nd:YLF laser. DOE

**N88-18906#** Sandia National Labs., Livermore, Calif.
**NONLINEAR ABSORPTION OF CO2 LASER RADIATION IN p-TYPE InSb**
R. B. James, Y. C. Chang, and D. L. Smith Dec. 1987 9 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987 Prepared in cooperation with Illinois Univ., Urbana and Los Alamos National Lab., N. Mex.
(Contract DE-AC04-76DR-00789)
(DE88-004055; SAND-87-8930; CONF-871147-5) Avail: NTIS HC A02/MF A01

Calculations of the intervalence-band absorption saturation in p-type InSb by high-intensity CO2 laser light are reported. The intensity-dependent absorption coefficient is found to be well described by an inhomogeneously broadened two-level model, and values of the saturation intensity are presented. DOE

**N88-18907#** Lawrence Livermore National Lab., Calif.
**EXPERIMENTAL RESULTS OF A HIGH-GAIN MICROWAVE FEL OPERATING AT 140 GHz**
A. L. Throop, W. M. Fawley, R. A. Jong, T. J. Orzechowski, D. Prosnitz, E. T. Scharlemann, R. D. Stever, G. A. Westenskow, D. B. Hopkins, and A. M. Sessler 12 Nov. 1987 22 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987 Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab. and MIT, Cambridge
(Contract W-7405-eng-48)
(DE88-004358; UCRL-97706; CONF-8709110-17) Avail: NTIS HC A03/MF A01

The Electron Laser Facility (ELF) has been used to generate high peak-powers at 140 GHz, extending the operating range of the device from previous experiments at 35 GHz. With 30 watts of input signal, an exponential gain of 21 dB/m and a saturated output power of over 50 MW were measured. Numerical tapering studies indicate that space charge effects were sufficiently large to affect trapping efficiency. Broadband spontaneous emission was observed over a wide range of wiggler fields at frequencies corresponding to free electron laser resonance. Over 150 MW of spontaneous power was measured near 94 GHz. The results are in good agreement with particle simulation codes. DOE

**N88-18908#** Sandia National Labs., Albuquerque, N. Mex.
**CALIBRATION OF BEAM POWER MONITORS FOR LASER WELDING**
Philip D. Thacher 1988 7 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004687; SAND-87-3033C; CONF-880110-10) Avail: NTIS HC A02/MF A01

Calibration of a Coherent Radiation Model 213 laser power sensor is reviewed. The calibration chain is traced from the National Bureau of Standards (NBS) through transfer calibrations to a working sensor. Uncertainty components in this chain, including those for use conditions, are combined to give a root-sum-square uncertainty of 7 percent for use of this device. DOE

**N88-18909#** Lawrence Livermore National Lab., Calif.
**SHAPE ISOMERS AS CANDIDATES FOR THE GAMMA RAY LASER STORAGE STATE**
M. S. Weiss Dec. 1987 14 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-48)
(DE88-005228; UCRL-96673-12/87; CONF-880110-14) Avail: NTIS HC A03/MF A01

Three Dimension Nuclear Hartree-Fock calculations have been performed for isotopes of Osmium, Mercury, and Tungsten. Many of the calculated potential energy surfaces show a second minimum at large prolate deformation indicating the possibility of shape isomeric states. Several are at sufficiently low energy to be possible candidates as storage states for the gamma ray laser. DOE

**N88-18910*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A LASER COMMUNICATION EXPERIMENT UTILIZING THE ACT SATELLITE AND AN AIRBORNE LASER TRANSCEIVER**
Charles E. Provencher, Jr. and Rodney L. Spence [1988] 26 p Presented at the Optoelectronics and Laser Applications in Science and Engineering (O-E LASE 88), Los Angeles, Calif., 10-17 Jan. 1988; sponsored in part by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-100792; E-3967; NAS 1.15:100792) Avail: NTIS HC A03/MF A01 CSCL 20E

The launch of a laser communication transmitter package into geosynchronous Earth orbit onboard the Advanced Communications Technology Satellite (ACTS) will present an excellent opportunity for the experimental reception of laser communication signals transmitted from a space orbit. The ACTS

laser package includes both a heterodyne transmitter (Lincoln Labs design) and a direct detection transmitter (Goddard Space Flight Center design) with both sharing some common optical components. NASA Lewis Research Center's Space Electronics Division is planning to perform a space communication experiment utilizing the GSFC direct detection laser transceiver. The laser receiver will be installed within an aircraft provided with a glass port for the reception of the signal. This paper describes the experiment and the approach to performing such an experiment. Described are the constraints placed on the NASA Lewis experiment by the performance parameters of the laser transmitter and by the ACTS spacecraft operations. The conceptual design of the receiving terminal is given; also included is the anticipated capability of the detector. Author

**N88-18911#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
**THE YAlO(SUB 3):Er LASER**
H. P. Weber and W. Luethy 10 Jul. 1986 14 p
(PB88-130877; MM:1986/87-LY-1) Avail: NTIS HC A03/MF A01 CSCL 20E

Absorption and fluorescence properties of 1.25 percent and 50 percent YAlO3:Er(3+) are summarized. Laser properties at room temperature are studied, in particular the polarization dependence. New laser lines at 1.7 micron are reported and the laser transitions in the 3 micron range are discussed. Author

**N88-18912#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
**METASTABLE MATERIALS BY LASER IRRADIATION**
M. vonAllmen 5 May 1986 17 p
(PB88-130364; MM:1985/86-ALLM-17) Avail: NTIS HC A03/MF A01 CSCL 20E

A short review is presented of recent work on laser produced metallic glasses and other metastable phases. For details, refer to the cited original publications. Author

**N88-18913#** Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
**SURFACE FREE ENERGY OF LASER-PRODUCED BOND PERCOLATORS**
M. Thuillard and M. vonAllmen 7 Oct. 1986 15 p
(PB88-130885; MM:1986/87-ALLM-6) Avail: NTIS HC A03/MF A01 CSCL 20E

Pulsed laser irradiation of thin metallic films on nonwetted substrates creates two dimensional bond perculator structures. It is shown that these can be understood as frozen minimum free energy configurations. The spacing between nodes is found to depend linearly on the initial film thickness, as verified experimentally for the case of a Ti film on sapphire. Author

**N88-18914#** Lawrence Livermore National Lab., Calif.
**FRACTURE MECHANISMS AND STRENGTHENING OF SLAB LASERS**
J. E. Marion Jan. 1987 14 p Presented at OE/LASE '87, Los Angeles, Calif., 11 Jan. 1987
(Contract W-7405-eng-48)
(DE88-004002; UCRL-95880; CONF-870132-18) Avail: NTIS HC A03

The fracture mechanisms of slab lasers are examined and the critical defects, induced during optical fabrication, are identified. A rationale for determining an appropriate operating stress for the slab laser is outlined, based on Weibull statistics, and this method is experimentally assessed in full-sized slab fracture tests. Techniques for achieving strong slabs are then examined. We determine that strengthening by subsurface damage minimization has the highest potential for strengthening, but that slab durability must also be enhanced in order for the slab to remain strong in practice. Good chemical durability is achieved by the use of water-proof overcoats. Good mechanical durability is achieved by the use of compressive surface layers. The compressive surface layers prevent the deterioration in slab strength from physical damage to the slab surface. DOE

**N88-18915#** Sandia National Labs., Albuquerque, N. Mex.
**QUENCHED-LASER OPERATION OF A LITTMAN DYE OSCILLATOR**
T. D. Raymond, C. Reiser, P. Esherick, and R. B. Michie 1987 6 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988 Prepared in cooperation with Mission Research Corp., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-004020; SAND-87-3074C; CONF-880110-5) Avail: NTIS HC A02/MF A01

We demonstrate a means of generating narrowband, tunable laser pulses near 650 nm with continuously adjustable pulse width from 0.2 to 3 nsec. The system utilizes a short-cavity single-mode Littman oscillator which is quenched by a second short-cavity dye laser. Both are pumped by the same 6-nsec full-width-at-half-maximum (FWHM) frequency-doubled single-mode Nd:YAG laser. We also demonstrate a polarization technique in the three-stage amplification of these pulses to an energy of 20 mJ with minimum temporal broadening. DOE

**N88-18916#** Los Alamos National Lab., N. Mex.
**ICF RESEARCH AT LOS ALAMOS**
P. D. Goldstone, J. R. Ackerhalt, L. S. Blair, D. C. Cartwright, C. A. Foreman, A. Hauer, D. E. Hanson, J. K. Hoffer, R. Kristal, and C. A. Fenstermacher 1987 28 p Presented at the 8th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, Calif., 27 Oct. 1987
(Contract W-7405-eng-36)
(DE88-005394; LA-UR-88-260; CONF-871093-4) Avail: NTIS HC A03/MF A01

It is apparent that short wavelength lasers (less than 500 nm) provide efficient coupling of laser energy into ICF target compression. KrF lasers (248 nm) operate at near-optimum wavelength and provide other potential benefits to ICF target coupling (e.g., bandwidth) and applications (high wallplug efficiency and relatively low cost). However, no driver technology has yet been shown to meet all of the requirements for a high-gain ICF capability at a currently acceptable cost, and there are still significant uncertainties in the driver-target coupling and capsule hydrodynamics that must be addressed. The Los Alamos research program is designed to assess the potential of KrF lasers for ICF and to determine the feasibility of achieving high gain in the laboratory with a KrF laser driver. Major efforts in KrF laser development and technology, target fabrication and materials development, and laser-matter interaction and hydrodynamics research are discussed. DOE

**N88-18758#** Joint Publications Research Service, Arlington, Va.
**OPERATION OF ELECTRON-BEAM CONTROLLED CO2 LASER AT 6 ATMOSPHERES**
Wuming Guo, Hongyao Yang, Jianwei Wang, Yizhuang Xu, and Nianle Wu *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 14-21 Transl. into ENGLISH from Guangxue Xuebao (Acta Optica Sinica), (Shanghai, China), v. 7, no. 2, Feb. 1987 p 120-125 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

**N88-18779*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A 2.3-GHz MASER AT USUDA, JAPAN, FOR TDRSS-ORBITING VLBI EXPERIMENT**
R. B. Quinn *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 40-42 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 20E

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**N88-18917#** Army Armament Research and Development Command, Dover, N. J. Fire Support Armament Center.
**VOICE/NATURAL LANGUAGE INTERFACING FOR ROBOTIC CONTROL**
Edward J. Carroll and Ken Lam Nov. 1987 27 p
(AD-A187765; ARFSD-TR-87008) Avail: NTIS HC A03/MF A01 CSCL 12I

This work examined past and present methods for adapting speech control to computer use. The research resulted in the development of a design methodology for implementation of a processing module to convert from single, spoken, natural language statements to a computer oriented control language. Specifically, it was designed to take the form of a small, stand alone computer board emulated by an IBM-PC and function as an expert system to translate English statements to a command set appropriate for controlling a Unimation PUMA-560 robotic arm. Even with speech control of the PUMA, the operator was still required to understand the system's capabilities and limitations. However, many of the operating difficulties, resulting from the robot's non-user-friendly programming procedures, were eliminated. GRA

**N88-18918#** Naval Postgraduate School, Monterey, Calif.
**DYNAMIC MODELLING OF AN ELECTROMECHANICAL VALVE USING FREQUENCY RESPONSE DATA Progress Report, Jun. 1986 - Sep. 1986**
Robert L. Miller and David L. Smith 15 Dec. 1986 21 p
(AD-A187908; NPS-69-86-012PR) Avail: NTIS HC A03/MF A01 CSCL 13K

Dynamic modelling of electromechanical parts is often accomplished by conducting an analysis from first physical principles. While this is always a useful effort for physical insight, it may lead to transfer function models which are unnecessarily complex. This paper presents a supplementary dynamic modelling method based on frequency response data. The method is applied to modelling of a globe valve used for water flow control. GRA

**N88-18919#** Colorado Univ., Boulder.
**TIME VARYING CONTROLLER DESIGN FOR ROBOT MANIPULATOR CONTROL Final Report, 1 Jul. 1984 - 31 Jun. 1987**
M. Y. Wu, N. M. Arbouz, and M. F. Chonika 25 Aug. 1987 135 p
(Contract N00014-84-K-0425)
(AD-A188094; CU-1536900) Avail: NTIS HC A07/MF A01 CSCL 13I

This report studies the design of time-varying controller for robot manipulator control. Piece-wise constant time-varying controller is shown to be capable of producing desired fast response without causing overshoot. Such response can not be achieved with time-invariant controller. Nonlinear feedback linearization method is used to transform nonlinear robot equation into decoupled sets of second-order linear equations so that time-varying controller can be designed. Stability of time-varying system and time-varying control based on learning algorithm are also presented. This report is comprised of the following four parts: (1) Robot Manipulator Controller Design: It was demonstrated that time-varying controllers can produce more desirable performances than those of time-invariant ones; (2) Stability of Time-Varying System: An important observation was made regarding stability in the design of time-varying systems. Implications of magnitude of change, and rate of change of parameter variations on stability are noted; (3) Learning Controller Design: One particular time-varying controller design approach that is of most interest to robot control is the learning control method. This part presents some preliminary results on learning control theory; and (4) A collection of papers on work which are in part supported by this ONR contract. GRA

**N88-18920#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**REDUCTION OF RESIDUAL STRESSES AND DISTORTION IN GIRTH WELDED PIPES M.S. Thesis**
Pamela K. Barnes Jun. 1987 114 p
(Contract N00228-85-G-3262)
(AD-A187728) Avail: NTIS HC A06/MF A01 CSCL 11F

Conventionally, welding control has been used to assure that the quality of the weld itself is maintained. Residual stresses and distortion result from the non-uniform temperature distribution which form the weld process. In this thesis, an investigation into the reduction of residual stresses and distortion is performed. Potential benefits of reducing these include prevention of stress corrosion cracking, fatigue, brittle fracture and collapse strength. In an attempt to reduce residual stresses and distortion, a hydraulic restraining device was designed, constructed and tested. It was then compared to several other methods being investigated. This hydraulic restraining device is very effective in reducing the radial contraction. Although it also reduces the residual stresses, it does not change them from tensile to compressive as some of the other methods do. Author

**N88-18921#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**FURTHER DEVELOPMENT OF A FINITE ELEMENT MODEL OF ORTHOGONAL METAL CUTTING Final Report**
J. S. Strenkowski 20 Oct. 1987 143 p
(Contract W-7405-eng-48)
(DE88-004048; UCRL-15984) Avail: NTIS HC A07/MF A01

This report summarizes the improvement of two finite element models of orthogonal metal cutting. The research effort took place from January 1985 to September 1987. Two contracts were awarded during this period, each aimed at specific improvements to the two models. The first contract consisted of four tasks, which concentrated on the further development of a NIKE2D metal cutting model. These included the following: the criterion for separation of finite element nodes into chip and workpiece near the tool tip; the most appropriate treatment of the stress concentration near the tool tip; the addition of thermal effects to the calculations, including heating from plastic work and interfacial friction, thermoelastic-plastic material properties, internal heat conduction and free-surface heat removal; and in collaboration with the Lawrence Livermore National Laboratory (LLNL), North Carolina State University (NCSU) shall conduct parameter studies, based on the existing state of code development, for factors such as tool edge radius, rake angle, etc., aimed at comparisons with experiment and guidance of code development. The second contract called for improvements to a second type of finte element model of orthogonal metal cutting. This model is called the Eulerian model because it simulates the workpiece in the vicinity of the cutting tool as an Eulerian flow field. The tasks under this contract included the following: development of a free surface algorithm for chip geometry for the cutting model; preliminary development of a transient Eulerian cutting model; and assessment of the use of an Eulerian model to study the onset of shear band formation and built-up edge as a function of cutting conditions, such as cutting speed, depth of cut, rake angle, and material properties. DOE

**N88-18922#** Sandia National Labs., Albuquerque, N. Mex.
**IN SITU ULTRAHIGH VACUUM FRICTION MEASUREMENT AND WEAR TRACK ANALYSIS OF ION IMPLANTED 304 STAINLESS STEEL**
L. E. Pope, D. M. Follstaedt, J. A. Knapp, and J. C. Barbour 1987 12 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-004537; SAND-87-1607C; CONF-871124-25) Avail: NTIS HC A03/MF A01

The dual ion implantation of Ti and C into 304 stainless steel has been found to reduce friction and wear in UHV. The implantation treatment producting this result, 4.6 x 10 to the 17th power Ti/square cm (180 keV) followed by 2.0 x 10 to the 17th

power C/square cm (50 keV), produced TiC precipitates dispersed in an amorphous surface layer. Friction and wear track compositions were measured in situ with a scanning Auger microprobe without removing the pin from the track. This treatment decreased the friction coefficient from 1.2 to 0.6 to 0.8 and the wear track width from 342 microns to 225 microns after 1000 cycles. Relative to unimplanted 304, wear tracks formed in UHV and air on implanted 304 had more N and less C, with O and the metallic elements similar in concentration, in addition to the presence of Ti. Friction coefficients measured in air were less than those in UHV; track composition suggests that oxides or adsorbed moisture (and perhaps hydrocarbons) helped lower the friction in air. DOE

**N88-18923#** Sandia National Labs., Albuquerque, N. Mex. Switching Devices Div.
**KINEMATIC AND DYNAMIC ANALYSES OF THE STANFORD/JPL ROBOT HAND**
Victor J. Johnson and Gregory P. Starr (New Mexico Univ., Albuquerque.) Nov. 1987 59 p
(Contract DE-AC04-76DP-00789)
(DE88-004637; SAND-86-2972) Avail: NTIS HC A04/MF A01

This report develops the kinematic and dynamic equations for one finger of the three-fingered Stanford/JPL robot hand and documents the physical parameters needed to implement the equations. The equations can be used in control schemes for position and force control of the Stanford/JPL robot hand. The output file for the MACSYMA program is given. DOE

**N88-18924#** Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.
**AUTOMATIC RIVETING MACHINE FOR SPHERICALLY-FORMED AIRFRAME STRUCTURES Final Report, 31 Jan. 1985**
Karl Hausmann, Klaus Groth, and Bernd Haberkorn Bonn, West Germany Bundesministerium fuer Forschung und Technologie Jan. 1985 113 p In GERMAN; ENGLISH summary
(Contract BMFT-LVS-7907I2)
(ETN-88-91024) Avail: NTIS HC A06/MF A01

A numerically controlled riveting machine was developed and constructed in order to guarantee the competitiveness of the Airbus passenger aircraft on the world market by reducing manufacturing costs and production time. The 5(6)-axis riveting machine can rivet spherically formed shell sections due to a high degree of automation, and more economically than riveting machines available on the market. Techniques required for the automatic riveting of shell sections were developed using robots, and tested for the processes of clip setting and clip frame connection. The automatic riveting procedure also improves working conditions, especially by the elimination of the riveting noise. ESA

**N88-18925#** Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
**CONCEPT AND ANALYSIS OF A DIRECT-INJECTION ALCOHOL LAYER CHARGE MOTOR Ph.D. Thesis [KONZEPTION UND ANALYSE EINES DIREKTEINSPRITZENDEN ALKOHOL-SCHICHTLADUNGSMOTORS]**
Volkher Weissermel 1987 220 p In GERMAN
(ETN-88-91482) Avail: NTIS HC A10/MF A01

The use of alcohol as an alternative fuel for diesel motors was investigated. The suitability of methanol and ethanol as fuels is discussed. The test motor and test stand are described. The test results and the thermodynamic analysis show that the alcohol fuel consumption is the same as that of direct-injection diesel motors. The amount of all toxic exhaust gases is reduced compared to diesel motors, if an oxidation catalyst is provided, and a part of the values remains significantly below the American emission limits. ESA

**N88-18926#** Institut Franco-Allemand de Recherches, St. Louis (France).
**NUMERICAL SIMULATION OF THE PERFORATION OF THIN PLATES Final Report [NUMERISCHE SIMULATION DER DURCHSCHLAGS DUENNER PLATTEN SIMULATION NUMERIQUE DE LA PERFORATION DE PLAQUES MINCES]**
R. Hunkler and G. Paulus 3 Sep. 1986 56 p In FRENCH and GERMAN
(Contract BMVg-T/R760/E0008/E1708)
(ISL-R-122/86; ETN-88-91644) Avail: NTIS HC A04/MF A01

The perforation of thin plates due to the impact of projectiles with several perforating elements made of steel or tungsten alloy was simulated using a computer program. Perforation of 2.5 to 5 mm thick steel plates by 5mm diameter projectiles was simulated, at impact velocities from 500 to 1000 m/sec. Agreement between calculation and measurement is good for velocities up to 700 m/sec, but above this phenomena which the code does not take into account, e.g., splinter formation, become important, and the results are less satisfactory. ESA

**N88-18927** Wisconsin Univ., Madison.
**REAL-TIME KINEMATIC AND DYNAMIC ANALYSIS AND ADAPTIVE MODEL FOLLOWING CONTROL OF MANIPULATOR ARMS Ph.D. Thesis**
Behzad Ghavimi 1987 230 p
Avail: Univ. Microfilms Order No. DA8719100

The fundamental aspects of on-line, real time trajectory generation and trajectory tracking of multi-degree-of-freedom manipulator arms was studied. Algorithms were developed for efficient computation of the kinematic and dynamic equations of mechanical manipulators. The algorithms are general in nature and can be applied to manipulators having revolute and prismatic joints. For real-time trajectory generation, a computationally efficient algorithm was developed to solve the direct and inverse kinematics of manipulators. The algorithm is recursive in nature and uses an iterative procedure to solve the inverse kinematics. Next, an efficient Lagrangian formulation of manipulator arm dynamics was developed. The efficiency of the proposed algorithm is due to the recursive computation of the velocities, accelerations, and generalized forces. It was shown that the proposed algorithm is the most efficient dynamics formulation of manipulators when compared to all other existing Langrangian based dynamics formulations. The achievement of high quality dynamic performance of manipulator robots using conventional controllers is difficult due to the manipulator nonlinearities and payload variations.
Dissert. Abstr.

**N88-18928** Notre Dame Univ., Ind.
**ANALYSIS AND SYNTHESIS OF TWO DEGREES OF FREEDOM CONTROL SYSTEMS Ph.D. Thesis**
Oscar Raul Gonzalez 1987 262 p
Avail: Univ. Microfilms Order No. DA8725076

The linear, time invariant finite dimensional, multivariable control system denoted by Sigma (S sub p, S sub c) is studied. The system consists of a general plant S sub p, where the controlled and measured variables are not necessarily the same, and a general linear compensator S sub c, that is, a two degrees of freedom compensator. A goal of the analysis is to maintain insight into the properties of Sigma (S sub p, S sub c). This is done by working closely to internal descriptions of the systems. A very useful approach that maintains a relation to internal descriptions and helps in the analysis and synthesis of linear multivariable systems is the factorization of transfer function matrices. Polynomial matrix factorizations and factorizations over appropriate rings are used. The former ones are tightly related to internal descriptions; the latter ones are useful to simplify the analysis of control problems. A comprehensive study of internal stability of Sigma (S sub p, S sub c) is made. The regulation and asymptotic tracking problems with internal stability are formulated and analyzed in a ring setting. Finally, a block realization method is formulated for the synthesis of compensators and some solution comments are made. Dissert. Abstr.

**N88-18929** Maryland Univ., College Park.
**SYMMETRIES IN NONLINEAR CONTROL SYSTEMS AND THEIR APPLICATIONS Ph.D. Thesis**
Jae Hong Han 1987 191 p
Avail: Univ. Microfilms Order No. DA8725397

Symmetries of nonlinear control systems and optimal control problems are defined by following an infinitesimal approach. An algorithm to determine the symmetries is also developed. As applications, the modeling problem for systems which admit certain symmetries is considered and a decomposition theory is studied using symmetry principles. Also reduction and reduced linearization problems are solved via symmetries, and associated optimal control problems are discussed. Using the methods of bifurcation under symmetry, the problem of local feedback stabilization is also studied. Dissert. Abstr.

**N88-18930** Oklahoma State Univ., Stillwater.
**PREDICTION OF THE RESPONSE AND OPTIMAL CONTROL OF STOCHASTIC PARAMETRICALLY AND EXTERNALLY EXCITED NONLINEAR SYSTEMS Ph.D. Thesis**
Ren-Jung Chang 1987 141 p
Avail: Univ. Microfilms Order No. DA8724531

A new physical concept called equivalent external excitation is introduced. Following this concept, a parametric and external noise excited system can be interpreted as an equivalent system which is excited solely by an equivalent external noise. Through the use of matching conditions to adjust the effects of noise intensity, a nonlinearization technique is developed for the accurate prediction of the stationary response statistics of nonlinear stochastic systems. The techniques and criterion of Gaussian and non-Gaussian linearization are also derived for the accurate prediction of the stationary output variances of the states of nonlinear stochastic systems. By employing the concepts of equivalent external excitation and nonlinear compensation, a nonlinearization approach is developed for the optimal control of nonlinear stochastic systems. The improvement of the output variances of the system states by applying the proposed controller over the Gaussian linearization approach is greater than ten percent for the systems investigated. Dissert. Abstr.

**N88-18931** Maryland Univ., College Park.
**IMPROVEMENT IN ROBOT POSITIONING ACCURACY BY A KINEMATIC IDENTIFICATION MODEL Ph.D. Thesis**
Lih-Ming Chao 1987 267 p
Avail: Univ. Microfilms Order No. DA8725381

The accurate positioning of an articulate robot is dependent upon the correctness of the robot kinematic linkage mechanism. The desired or nominal linkage mechanism is never achieved due to errors in the manufacturing and assembling processes. In addition to these geometric error sources, there are non-geometric error sources from flexibility and backlash within the linkage mechanism. Also, the objects handled by the robot may have sufficient weight to deflect the robot mechanism. This is an external error source. A method for modeling a parameterized robot positioning mechanism was developed to accommodate the error behavior. Real measurements of robot and effector position were performed for a number of specific robots using a theodolite 3-D coordinate measuring system or by using a specially designed laser interferometric instrument for measuring distance. The parameterized model is identified using these accurate data. In each case, two sets of data were collected. One is used to identify the parameters. The other is used to check the positioning accuracy of the new mechanism model. Results show that an order of magnitude improvement in robot positioning accuracy can be achieved. Dissert. Abstr.

**N88-18932** Florida Univ., Gainesville.
**MOTION PLANNING AND CONTROL OF ROBOT MANIPULATORS VIA APPLICATION OF A COMPUTER GRAPHICS ANIMATED DISPLAY Ph.D. Thesis**
Carl David Crane, III 1987 193 p
Avail: Univ. Microfilms Order No. DA8724899

It is often necessary in a hazardous environment for an operator to effectively control the motion of a robot manipulator which cannot be observed directly. A computer graphics based system was developed which provides an operator with an improved method of planning, evaluating, and directly controlling robot motions. A graphics program which operates in a Silicon Grpahics IRIS workstation was developed which provides the visual imagery. The graphics system is capable of generating a solid color representation of the manipulator at refresh rates in excess of 10 Hz. This rapid image generation rate is important in that it allows the user to zoom in, change the vantage point, or translate into real time. A obstacle collision warning feature was also incorporated into the system. Obstacles are monitored to determine whether any part of the manipulator comes close of strikes the object. The collision warning algorithm utilizes custom graphics hardware in order to change the color of the obstacle and produce an audible sound as a warning if any part of the manipulator approaches closer than some established criterion. The obstacle warning calculations are performed continuously and in real time. The graphics system which was developed has advanced man-machine interation in that imporved operator efficiency and confidence has resulted. Continued technological developments and system integration will result in much more advanced interface systems in the future. Dissert. Abstr.

**N88-18933*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**COMPUTER-AIDED DESIGN ANALYSIS OF 57-MM, ANGULAR-CONTACT, CRYOGENIC TURBOPUMP BEARINGS**
Elizabeth S. Armstrong and Harold H. Coe Mar. 1988 15 p
(NASA-TP-2816; E-3890; NAS 1.60:2816) Avail: NTIS HC A03/MF A01 CSCL 13K

The Space Shuttle main engine high-pressure oxygen turbopumps have not experienced the sevice life required of them. This insufficiency has been due in part to the shortened life of the bearings. To improve the life of the existing turbopump bearings, an effort is under way to investigate bearing modifications that could be retrofitted into the present bearing cavity. Several bearing parameters were optimized using the computer program SHABERTH, which performs a thermomechanical simulation of a load support system. The computer analysis showed that improved bearing performance is feasible if low friction coefficients can be attained. Bearing geometries were optimized considering heat generation, equilibrium temperatures, and relative life. Thermal gradients through the bearings were found to be lower with liquid lubrication than with solid film lubrication, and a liquid oxygen coolant flowrate of approximately 4.0 kg/s was found to be optimal. This paper describes the analytical modeling used to determine these feasible modifications to improve bearing performance.
Author

**N88-18934#** National Academy of Sciences - National Research Council, Washington, D. C.
**REVIEW OF THE STATE OF THE ART AND PROJECTED TECHNOLOGY OF LOW HEAT REJECTION ENGINES Final Report**
1987 190 p
(Contract DE-AC01-84CD-90142)
(PB88-131255) Avail: NTIS HC A09/MF A01 CSCL 10B

The Committee on Adiabatic Diesel Technology reviewed the state of the art and projected development of adiabatic engines. The term adiabatic means no heat transfer to or from a system and, in context of an internal combustion engine, refers to the insulation of the combustion chamber and other parts of the engine to reduce heat loss to the cooling system and environment (this is referred to as a Low Heat Rejection Engine, LHRE). However, the term adiabatic has come to connote other advanced engine developments occurring in conjunction with the development of LHREs, such as exhaust energy recovery. The LHREs can be designed in a variety of ways, one of which uses ceramic coatings or ceramic parts to cut down on heat transfer and withstand the much higher temperatures which exist in LHREs. These was a great deal of development over the last 12 years in the U.S.,

Europe, and Japan to develop the technology and measure the performance benefits. These were expectations of improved fuel economy, reduced cooling system size, increased power density, higher reliability and durability, enhanced multi-fuel capability, and reductions in emissions. To carry out its assessment, the committee visited many laboratories and persons in the U.S., Japan, and Europe. GRA

# 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N88-18935#** Army Armament Research and Development Command, Dover, N. J. Armament Engineering Directorate.
**NOVEL ANALYTICAL X-RAY NON-DESTRUCTIVE EVALUATION (NDE) TOOL FOR QUALITY CONTROL OF ENERGETIC MATERIALS**
Ronald G. Rosemeier, T. S. Ananthanarayanan, Sudhir B. Brivedi, Alfred L. Wiltrout, and Douglas C. Leepa 12 Oct. 1987 37 p
(AD-A187737; ARAED-CR-87024) Avail: NTIS HC A03/MF A01 CSCL 14B

Factors affecting the stability of energetic materials are not well understood. Knowledge of these factors is essential for the predictability and hence the successful applications of energetic materials as explosives and/or propellants. This in turn involves study of energetic reactions and reaction parameters. The effects of lattice defects, particle size, temperature, radiation and mechanical impact on the initiation and subsequent propagation of solid-state decomposition reaction have been studied by several researchers. However, the identification and understanding of factors governing energetics in these reactions is not achieved as of yet. This problem in our opinion can be understood in terms of the microstructure of these materials. This report focuses on the study of microstructure of energetic materials using novel non-destructive, non-intrusive X-ray diffraction techniques developed at Brimrose. GRA

**N88-18936#** Army Armament Research and Development Command, Dover, N. J. Product Assurance Directorate.
**REFERENCE STANDARDS FOR NONDESTRUCTIVE TESTS**
Henry Hartmann Oct. 1987 39 p
(AD-A187766; ARPAD-TR-87006) Avail: NTIS HC A03/MF A01 CSCL 11F

Reference standards are the prime element of nondestructive tests. Standards contain the flaw or a simulated representation that is being sought, such as cracks, and these flaws are in a geometry that simulates the parts to be tested. This report emphasizes cracks in metal parts, how to calculate crack sizes, and how to simulate cracks in reference standards. GRA

**N88-18937*#** Morton Thiokol, Brigham City, Utah. NDT Lab.
**STA-2A NDT TESTING Final Report**
T. J. Lewis 25 Nov. 1987 117 p
(Contract NAS8-30490)
(NASA-CR-179301; NAS 1.26:179301; TWR-17748; DR-5-3)
Avail: NTIS HC A06/MF A01 CSCL 14D

The nondestructive testing (NDT) on the Space Shuttle Solid Rocket Booster (SRB) filament wound case (FWC) short stact structural test articles 2 (STA-2A) during test of phases 1B-9C is described. The primary objective of this testing was to verify the structural integrity of the SRB-FWC for critical design loads. Another objective was to quantify the effect of load distributions in the aft skirt. The NDT objectives were to determine the acoustic emission characteristics of the FWC-SRB and to identify possible design deficiencies or defect growth. The results from the posttest inspection of the samples shows the depth measurements taken were accurate until exceeding .260 inches thickness. The data then show that pulse echo measurements exceeded actual part thickness by 10 to 14 percent. The mapping of forward boundaries of delaminations proved to be within the tolerance of the equipment. Using the ZIP probe, the maximum difference between the pulse echo boundary and the visual boundary was expected to be no greater than one half the diameter of the probe. The NDT performance on STA-2A shows how NDT can be used to assist design engineering in evaluating the structural integrity of composite test articles. B.G.

**N88-18938#** Rockwell International Corp., Golden, Colo.
**MEASUREMENTS AS A PROCESS**
Y. M. Ferris 18 Nov. 1987 5 p
(Contract DE-AC04-76DP-03533)
(DE88-005275; RFP-4183) Avail: NTIS HC A02/MF A01

The author defines measurement as a process analogous to any manufacturing or fabrication activity. Those aspects of measurement which support this view are outlined. These include design of the measurement process to meet user requirements, training to perform the measurement process, quality assurance considerations, and documentation and procedures capable of being scrutinized by auditors. DOE

**N88-18939#** Technical Research Centre of Finland, Espoo.
**ULTRASONIC TESTING OF HEAT EXCHANGER TUBES**
K. Lahdenperae, J. Pitkaenen, and A. Lipponen Jul. 1987 27 p In FINNISH
(DE88-751172; VTT-TIED-734) Avail: NTIS (US Sales Only) HC A03/MF A01

Ultrasonic equipment for internal inspection of condenser tubes has been acquired. The testing speed is 25 mm/s if 100 percent coverage is required. The internal diameter of the tubes to be tested can be from 13 mm to 20 mm. Water is used as a coolant. The inaccuracy of the testing is 0.1 mm. The wall thickness exceeding 0.9 mm can be measured if the corrosion is external. The smallest holes that can be found have a 1.5 mm diameter. The equipment can be used also for analyzing results of eddy current inspection. DOE

**N88-18940#** Technische Univ., Berlin (West Germany). Fachbereich Elektrotechnik.
**IMAGING METHODS FOR NONDESTRUCTIVE MATERIALS TESTING Ph.D. Thesis [BILDGEBENDE VERFAHREN IN DER ZERSTOERUNGSFREIEN MATERIALPRUEFUNG]**
Michael Schmidt 1987 92 p In GERMAN
(ETN-88-91477) Avail: NTIS HC A05/MF A01

Methods for the electronic processing of ultrasonic signals from phased array antennas are presented for nondestructive testing of thick-walled materials. The fundamentals of imaging methods using ultrasonic waves are explained. The ultrasonic test equipment, developed following the phased array principle, is described. The test results demonstrate the high resolution and the good prediction capability of the method. The signal processing has to be improved in order to make the measurements more unequivocal and more accurate. Therefore a signal processing method that evaluates the cross correlation was developed. ESA

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

**N88-18941*#** Martin Marietta Aerospace, Denver, Colo.
**THE INTEGRATION OF A MESH REFLECTOR TO A 15-FOOT BOX TRUSS STRUCTURE. TASK 3: BOX TRUSS ANALYSIS AND TECHNOLOGY DEVELOPMENT Final Report, Apr. 1985 - Nov. 1986**
E. E. Bachtell, W. F. Thiemet, and G. Morosow Mar. 1987 75 p
(Contract NAS1-17551)
(NASA-CR-178228; NAS 1.26:178228; MCR-86-669-Task-3)
Avail: NTIS HC A04/MF A01 CSCL 20K

To demonstrate the design and integration of a reflective mesh surface to a deployable truss structure, a mesh reflector was installed on a 15 foot box truss cube. The specific features demonstrated include: (1) sewing seams in reflective mesh; (2) mesh stretching to desired preload; (3) installation of surface tie cords; (4) installation of reflective surface on truss; (5) setting of reflective surface; (6) verification of surface shape/accuracy; (7) storage and deployment; (8) repeatability of reflector surface; and (9) comparison of surface with predicted shape using analytical methods developed under a previous task. Author

**N88-18942#** Ballistic Research Labs., Aberdeen Proving Ground, Md.
**ON STRESS COLLAPSE IN ADIABATIC SHEAR BANDS Final Report**
Thomas W. Wright and John W. Walter Jun. 1987 4 p
(AD-A187185; BRL-TR-2816) Avail: NTIS HC A02/MF A01 CSCL 20K

The dynamics of adiabatic shear band formation is considered making use of a simplified thermo/visco/plastic flow law. A new numerical solution is used to follow the growth of a perturbation from initiation, through early growth and severe localization, to a slowly varying terminal configuration. Asymptotic analyses predict the early and late stage patterns, but the timing and structure of the abrupt transition to severe localization can only be studied numerically, to date. A characteristic feature of the process is that temperature and plastic strain rate begin to localize immediately, but only slowly, whereas the stress first evolves almost as if there were no perturbation, but then collapses rapidly when severe localization occurs. GRA

**N88-18943#** Stanford Univ., Calif. Div. of Applied Mechanics.
**THE HAMILTONIAN STRUCTURE OF NONLINEAR ELASTICITY: THE CONVECTIVE REPRESENTATION OF SOLIDS, RODS, AND PLATES**
Juan C. Simo, Jerrold E. Marsden, and P. S. Krishnaprasad Dec. 1986 63 p
(Contract DE-AT03-85ER12097; Grants AF-AFOSR-0073-87; NSF OIR-85-00108)
(AD-A187200; AFOSR-87-1384TR) Avail: NTIS HC A04/MF A01 CSCL 11G

It is our belief that a thorough understanding of the mathematical underpinnings of elasticity is crucial to its analytical and numerical implementation. For example, in the analysis of rotating structures, if one attempts to couple geometrically inexact models, obtained by linearization or other approximations to rotating rigid bodies, one can easily get serious artificial softening effects that can significantly alter numerical results; see Simo and Vu-Quoc for a discussion (compare equations of that paper). In this paper, we consider geometrically exact models, such as the Kirchhoff-Love-Reissner-Antman model for rods and its counterpart for plates and shells. These models take into account shear and torsion as well as the usual bending effects in traditional rod and plate models. Our purpose is to systematically develop the Hamiltonian structure for the dynamics of these models in the convective representation. The convective representation is chosen for its computational convenience and for our planned coupling of these models to the dynamics of rigid body motion, as in Krishnaprasad and Marsden. One of the topics that is of importance in the foundations of elasticity is a geometric formulation of the equations in Hamiltonian form. GRA

**N88-18944#** Army Construction Engineering Research Lab., Champaign, Ill.
**DETERMINATION OF THE ULTIMATE LOADS FOR CORRUGATED-STEEL, BARREL-TYPE SHELL STRUCTURES Final Report**
Demetres Briassoulis, Anthony Kao, and Steven Sweeney Oct. 1987 52 p
(AD-A187716) Avail: NTIS HC A04/MF A01 CSCL 13M

In this report, the ultimate snow and wind loads are determined for two sizes of a corrugated steel, barrel type shell building by using numerical and experimental methods. Local buckling is shown to govern the ultimate loading of these structures, through the formation of collapsing mechanisms. The critical positive and negative moment fields under which hinges are formed determine critical loads which will create the collapsing mechanisms. The lower bounds of the ultimate snow loads for the intermediate (50 ft wide by 18 ft high) and large (72 ft wide by 26 ft high) structures were found to be 35 psf and 14 psf, respectively. The ultimate wind velocities for the same intermediate and large structures were 87 to 110 mph and 60 to 74 mph, respectively. Although methods and assumptions used in the analysis are considered conservative, it does not indicate that with respect the wind loading, some existing structures may be operating at or near ultimate strength. GRA

**N88-18945#** Boston Univ., Mass. Coll. of Engineering.
**PARAMETRIC DEPENDENCE IN THE EQUILIBRIUM DYNAMICS OF ROTATING STRUCTURES Annual Report, 15 Apr. 1986 - 14 Apr. 1987**
John Baillieul 1 Jun. 1987 11 p
(Grant AF-AFOSR-0144-85)
(AD-A187817; AFOSR-87-1487TR) Avail: NTIS HC A03/MF A01 CSCL 20K

This report summarizes work done by the author during the past twelve months on the dynamics of complex rotating systems. Our recent work on the mechanics of rotating elastic structures shows a complex dependency of asymptotic equilibrium states on physical parameters such as elasticity of the material and total momentum of the structure. For multiply articulated rigid bodies undergoing large angle rotations, it is shown explicitly how there can be a sensitive dependence of equilibrium states on parameters of inertia and angular momentum. This suggests that recent work on geometrically nonlinear beam theories may be significant not only for transient analysis, but for accurately modeling asymptotic dynamics as well. GRA

**N88-18946#** California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
**UNSTABLE ELASTIC MATERIALS AND THE VISCO-ELASTIC RESPONSE OF BARS IN TENSION**
Rohan Abeyaratne and James K. Knowles Sep. 1987 10 p
(Contract N00014-87-K-0117)
(AD-A187969; TR-2) Avail: NTIS HC A02/MF A01 CSCL 20K

The force elongation relation (or macroscopic response) of a bar of unstable elastic material is in general dissipative. This note shows that the macroscopic response may be of conventional viscoelastic type. GRA

**N88-18947#** California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
**ON THE DISSIPATIVE RESPONSE DUE TO DISCONTINUOUS STRAINS IN BARS OF UNSTABLE ELASTIC MATERIAL**
Rohan Abeyaratne and James K. Knowles Sep. 1987 53 p
Prepared in cooperation with Massachusetts Inst. of Technology, Cambridge
(Contract N00014-87-K-0117)
(AD-A188114; TR-1) Avail: NTIS HC A04/MF A01 CSCL 20K

Some elastic materials are capable of sustaining finite equilibrium deformations with discontinuous strains. Boundary-value problems for such unstable elastic materials often possess an infinity of solutions, suggesting that the theory suffers from a constitutive deficiency. In the setting of the one-dimensional theory of bars in tension, the present paper explores the consequences of supplementing the theory with further constitutive information. This additional information pertains to the surface of strain discontinuity and consists of a kinetic relation and a criterion for the initiation of such a surface. We show that the quasi-static response of the bar to a prescribed force history is then fully determined. In particular, we observe how unstable elastic materials can be used to model macroscopic behavior similar to that associated with viscoplasticity. GRA

**N88-18948*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE 58TH SHOCK AND VIBRATION SYMPOSIUM, VOLUME 2**
Walter D. Pilkey, comp. and Barbara F. Pilkey, comp. (Virginia Univ., Charlottesville.) Feb. 1988 208 p Symposium held in Huntsville, Ala., 13-15 Oct. 1987; sponsored in part by DOD
(NASA-CP-2488-Vol-2; M-572-Vol-2; NAS 1.55:2488-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 20K

Dynamic analysis, dynamic testing, space shuttle main engine vibration, isolation and damping and analytical methods are among the topics discussed. For individual titles, see N88-18949 through N88-18958.

**N88-18949*#** Cincinnati Univ., Ohio. Structural Dynamics Research Lab.
**OVERVIEW OF MULTI-INPUT FREQUENCY DOMAIN MODAL TESTING METHODS WITH AN EMPHASIS ON SINE TESTING**
Robert W. Rost and David L. Brown *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 41-59 (For primary document see N88-18948 11-39)
(Contract F33615-83-C-3218)
Avail: NTIS HC A10/MF A01 CSCL 20K

An overview of the current state of the art multiple-input, multiple-output modal testing technology is discussed. A very brief review of the current time domain methods is given. A detailed review of frequency and spatial domain methods is presented with an emphasis on sine testing. Author

**N88-18950*#** NKF Engineering, Inc., Reston, Va.
**DYNAMIC SUBSTRUCTURING FOR SHOCK SPECTRUM ANALYSIS USING COMPONENT MODE SYNTHESIS**
Barton W. McPheeters, Avivi Lev, Philip B. Bogert, and Rudolph J. Scavuzzo *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 63-77 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 20K

Component mode synthesis was used to analyze different types of structures with MSC NASTRAN. The theory and technique of using Multipoint Constraint Equations (MPCs) to connect substructures to each other or to a common foundation is presented. Computation of the dynamic response of the system from shack spectrum inputs was automated using the DMAP programming language of the MSC NASTRAN finite element code. Author

**N88-18951*#** National Space Development Agency, Tokyo (Japan). Structural Test Dept.
**NASDA'S NEW TEST FACILITIES FOR SATELLITES AND ROCKETS** **c14**
Mitsuhiro Tsuchiya *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 79-90 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 09B

The National Space Development Agency of Japan (NASDA) has decided to construct integrated environmental and structural test facilities for large space satellites. These facilities are under construction. The new test facilities are described and some technical considerations, especially for the unique vibration test facility are discussed. Author

**N88-18952*#** General Electric Co., Philadelphia, Pa.
**DESIGN AND DYNAMIC TESTING OF AN INSTRUMENTED SPACECRAFT COMPONENT** **c18**
Thomas J. Dwyer *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 93-102 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 22B

Details relating to the design and subsequent vibration and shock tests of a spacecraft component for a severe vibration and shock environment are presented. The design process and analysis method involve the use of finite element analysis coupled with the Modal Strain Energy method with risk graphs to determine the adequacy of the design. The vibration levels experienced by box parts are reduced by the application of passive constrained layer viscoelastic treatments that significantly improve component reliability. All significant internal components were fully instrumented in both the random vibration and shock tests, the latter being done on a mechanical impact pyro simulator. Correlation between analysis and test data is good, validating the modeling and analysis techniques. Author

**N88-18953*#** Hughes Aircraft Co., Fullerton, Calif. Environmental Engineering Dept.
**RANDOM VIBRATION (STRESS SCREENING) OF PRINTED WIRING ASSEMBLIES** **c33**
Gilbert J. Bastien *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 111-147 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 09A

The results of a random vibration test screening (RVSS) study of the determination of the upper and lower vibration limits on printed wiring assemblies (PWA) are summarized. The study results are intended to serve as a guide for engineers and designers who make decisions on PWA features that need to withstand the stresses of dynamic testing and screening. The maximum allowable PWA deflection, G levels, and PSD levels are compared to the expected or actual levels to determine if deleterious effects will occur. Author

**N88-18954*#** Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
**ROCKETDYNE AUTOMATED DYNAMICS DATA ANALYSIS AND MANAGEMENT SYSTEM** **c82**
Robert B. Tarn *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 151-164 (For primary document see N88-18948 11-39)
(Contract NAS8-27980)
Avail: NTIS HC A10/MF A01 CSCL 05B

An automated dynamics data analysis and management systems implemented on a DEC VAX minicomputer cluster is described. Multichannel acquisition, Fast Fourier Transformation analysis, and an online database have significantly improved the analysis of wideband transducer responses from Space Shuttle Main Engine testing. Leakage error correction to recover sinusoid amplitudes and correct for frequency slewing is described. The phase errors caused by FM recorder/playback head misalignment are automatically measured and used to correct the data. Data compression methods are described and compared. The system hardware is described. Applications using the data base are introduced, including software for power spectral density, instantaneous time history, amplitude histogram, fatigue analysis, and rotordynamics expert system analysis. Author

**N88-18955*#** General Electric Co., Philadelphia, Pa. Astro Space Div.
**SPACECRAFT REDESIGN TO REDUCE MICROPHONIC RESPONSE OF A VCO COMPONENT** **c18**
J. C. Strain and S. Mittal *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 167-183 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 22B

Reaction wheel vibration was found to induce out of specification sidebands on the carrier frequencies of some spacecraft components containing mechanical voltage control oscillators (VCOs). Concurrent investigations were performed to redesign the VCOs to reduce their response to the wheel vibration, and to design a reaction wheel isolation system to reduce the vibration input to the affected components. Component level tests indicated that both efforts provided viable solutions. The redesigned VCO will be incorporated into future spacecraft in the series, while affected spacecraft already in production will be retrofitted with the reaction wheel isolation system. Author

**N88-18956*#** Dayton Univ., Ohio. Research Inst.
**A SUPERELEMENT COMPONENT DYNAMIC SYNTHESIS METHOD**
M. L. Soni *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 187-195 Sponsored in part by Cincinnati Univ., Ohio (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 20K

A method is presented for coupling a broad class of component dynamic models in the manner of direct stiffness assembly. The method is implemented in a general matrix manipulation program. Author

**N88-18957*#** Pennsylvania State Univ., McKeesport. Dept. of Mechanical Engineering.
**APPROXIMATE METHOD FOR PREDICTING THE PERMANENT SET IN A BEAM IN VACUO AND IN WATER SUBJECT TO A SHOCK WAVE**
A. L. Stiehl, R. C. Haberman, and J. H. Cowles (Bolt, Beranek, and Newman, Inc., New London, Conn.) *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 197-205 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 20K

An approximate method to compute the maximum deformation and permanent set of a beam subjected to shock wave laoding in vacuo and in water was investigated. The method equates the maximum kinetic energy of the beam (and water) to the elastic plastic work done by a static uniform load applied to a beam. Results for the water case indicate that the plastic deformation is controlled by the kinetic energy of the water. The simplified approach can result in significant savings in computer time or it can expediently be used as a check of results from a more rigorous approach. The accuracy of the method is demonstrated by various examples of beams with simple support and clamped support boundary conditions. Author

**N88-18958*#** Carrier Vibrating Equipment, Louisville, Ky.
**ELECTRO-MECHANICAL VIBRATORY SYSTEM**
Mario Paz *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 207-215 (For primary document see N88-18948 11-39)
Avail: NTIS HC A10/MF A01 CSCL 20K

The problem of predicting the phase angle of two self-synchronized rotors starting from rest is presented. It is shown that with insufficient power the rotors may not reach the final operating speed of the motors and stay locked at one of the lower natural frequencies of the vibrating system, thus producing large amplitude and failure of the equipment. Author

**N88-18959#** Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Civil and Architectural Engineering Dept.
**DERIVATION OF STRENGTH FACTORS RELATED TO THE COORDINATION OF THE STRENGTH OF TRANSMISSION LINE COMPONENTS**
T. J. Ploeg and A. J. vanLoon, ed. 1987 10 p
(S/T-Rept-Vol-5-No-2; B8711972; ISBN-90-353-0049-1; ISSN-0167-8590; ETN-88-91603) Avail: NTIS HC A02/MF A01; Kema N.V., Arnhem, The Netherlands DFL 14

The reliability analysis of transmission-line structures and a probability-based design methodology are described. The design of transmission lines requires that the strength of the various components be coordinated. A strength factor phi, related to the target coordination of strength or sequence of failure of the various components, was introduced in the general design equation. A method to derive the value of phi was developed. Phi values depend on the target probability of achieving the preferred sequence of failure. This method takes the random nature of the components' strength into account. The phi values for a confidence level of 90 percent were derived for different dispersions of component strength. ESA

**N88-18960** Cleveland State Univ., Ohio.
**MATHEMATICAL MODELING OF THE POSTBUCKLING BEHAVIOR OF STRUCTURAL ELEMENTS**
Poonsak Sritalapat 1986 209 p
Avail: Univ. Microfilms Order No. DA8726542

The postbuckling stability characteristics of a set of heuristically chosen mathematical models which illustrate the wide scope of behavior of structural elements including columns, arches, plates, and shells are investigated. Limit point, bifurcation point, trifurcation point, and snap-back phenomena are included. Both discrete 2 DOF and continuum models are utilized. Nonlinearities are included by geometry only since linear material laws are specified throughout. Combined effects of axial/membrane and rotation/bending actions are included. Nonlinear load displacement/rotation equations are formulated from energy techniques with no restrictions on the size of displacements or rotations. The coupled nonlinear algebraic equations of equilibrium are solved by the numerical Muller Method. For continua models the Elastica theory is used to couple axial and rotational behavior with the constraint of smallness of strain in comparison to unity. The classical Rayleigh-Ritz technique is used to transform the continuum equations into a set of nonlinear algebraic equations. Parametric studies of the bending/axial stiffness ratio are conducted to identify the broad scope of postbuckling behavior of structural elements. The effects of imperfection sensitivity are investigated particularly in the case of unstable postbuckling behavior. Dissert. Abstr.

**N88-18961** Wisconsin Univ., Madison.
**NUMERICAL-EXPERIMENTAL INVESTIGATION OF SINGULARITY AT A CRACK IN NONLINEAR RUBBER ELASTICITY Ph.D. Thesis**
Nabil Izzeddin AbuGharbieh 1987 228 p
Avail: Univ. Microfilms Order No. DA8719085

The purpose of this research is to study the nature of the singularity at the tip of a double crack emanating from a central circular hole in a tensile rubber sheet. The rubber exhibits both kinematic and material nonlinearities. The Moony-Rivlin constitutive relation was assumed and the material coefficients were evaluated experimentally. Rubber sheets were subjected to uniaxial tension such that the cracks were under large deformations Mode-I. Displacements in the vicinity of the crack tip were measured using the moire method. The linear case was first studied using the finite element programs LEARN and NONSAP. The strain singularity (n) in r to the -n was calculated and values of n = 0.5 were obtained in both cases at the tip of the crack without using singularity elements, thereby providing computational confidence. The nonlinear case was then analyzed numerically using NONSAP. The numerical results agreed with theoretical predictions more closely than the experimental measurements where a lower value of the singularity was obtained. All results indicate the singularity decreases with increased deformation. The Moony-Rivlin material model predicts the nonlinear elastic response reasonably well. Dissert. Abstr.

**N88-18962** Maryland Univ., College Park.
**THE STRESS FIELD SURROUNDING THE TIP OF A CRACK PROPAGATING IN A FINITE BODY Ph.D. Thesis**
Ravinder Chona 1987 166 p
Avail: Univ. Microfilms Order No. DA8725479

The relationship was established between a parameter descriptive of the trajectory of a smoothly curving crack, such as the curvature of the crack path, and the local stress state in the close vicinity of the crack tip. The behavior of fast running cracks propagating along straight and smoothly curving paths in fracture specimens of various geometries was examined using dynamic photoelasticity and representations of the running crack. Stress field were developed in terms of the coefficients of a set of infinite series, for both opening and shear mode loading conditions. Analysis of the isochromatic patterns, using local collocation methods based on this stress field representation, allowed the stress state in the neighborhood of the propagating crack tip to be modeled with a high degree of accuracy and results were

obtained for the variations with crack tip position of both the singular and leading non-singular stress field coefficients of interest. The results obtained for quasi-state and rapid crack propagation under opening mode conditions in a ring segment revealed the importance of retaining terms of order even when only the singular term was to be determined accurately. Dissert. Abstr.

**N88-18963** Wisconsin Univ., Madison.
**FRACTURE CHARACTERISTICS OF A VISCOELASTIC POLYMER UNDER CONSTANT LOAD: EXPERIMENTS AND ANALYSIS Ph.D. Thesis**
Thomas George Ebbott 1987 257 p
Avail: Univ. Microfilms Order No. DA8720456

The fracture response of a high density, high molecular weight polyethylene is investigated under creep loading using experimental, numerical, and theoretical methods. To assist the fracture investigation, a material model is developed from uniaxial creep tests and evaluated further with multiple-step tests, constant load rate tests, and experimental data for different loading configurations. The moire method is employed with double edge notched fracture specimens to obtain full-field, time-lapse displacement information. The effects of specimen thickness and load level on the fracture behavior are given special attention. A nonmonotonic crack growth process is identified through observed crack growth rates and crack tip opening displacements. Results from moire data are compared to predictions of linear and nonlinear viscoelastic theories with the aid of finite element analyses. Good correlations are found between the HRR fields and experimental near-tip strains for the thinnest specimen tested. Dissert. Abstr.

**N88-18964** Virginia Polytechnic Inst. and State Univ., Blacksburg.
**A NONLINEAR COMPUTATIONAL MODEL FOR THE STRENGTH AND FAILURE OF COMPOSITE PLATES AND SHELLS Ph.D. Thesis**
Ajay Kumar Pandey 1987 197 p
Avail: Univ. Microfilms Order No. DA8723928

Strength and failure analysis of laminated composite plates and shells are presented. A finite element algorithm for the analysis of laminated composite plates and shells was developed. The analysis is based on the first order shear deformation theory that accounts for the transverse shear strains and the geometric nonlinearity. Various macroscopic failure criteria are reviewed and were implemented in the finite element program. Failure analysis is preformed using several failure criteria. Once the failure has occurred, stiffnesses of the failed elements are reduced. A stiffness reduction technique is presented. Post-first-ply failure analysis is performed to obtain the failure sequence and failure loads. Various failure criteria are compared for the failure load and failure sequence. The maximum strain criterion in polynomial form and the Tsai-Hill criterion predict lower failure loads compared to other failure criteria under transverse loading. Results obtained in linear and geometrically nonlinear analyses are compared for the failure loads and locations. Dissert. Abstr.

**N88-18965** New South Wales Univ., Sydney (Australia).
**FRACTURE TOUGHNESS OF STEEL WELDMENTS CONTAINING LACK OF PENETRATION DEFECTS Abstract Only. Ph.D. Thesis**
Joseph Kadoma Byaruhanga Nov. 1986 357 p
Avail: Issuing Activity

The fracture resistance of weldments containing flaws in the as-welded state are investigated. The major aims were: the investigation of the possibility of fracture toughness testing using real defects such as lack of penetration as opposed to machined and fatigue cracked notches; the investigation of the effects of the welding process and procedure on fracture toughness; and investigation of the effects of factors such as notch geometry and angular distortion on the fracture toughness of weldments. The results revealed the following: lack of penetration defects and fatigue cracks gave similar fracture resistance values over a range of temperatures; specimens with shallow notches gave better fracture resistance values than those with standard notches; different welding processes and procedures gave different fracture resistance data; and specimens made with a restraining weld had better resistance to fracture than those allowed to distort during welding. Author

**N88-18966** New South Wales Univ., Sydney (Australia).
**NUMERICAL FRACTURE MECHANICS USING FINITE ELEMENT METHOD Abstract Only. Ph.D. Thesis**
Viriyawan Murti 1986 263 p
Avail: Issuing Activity

Propagating cracks under static and dynamic loadings have been modelled through remeshing using the Finite Element Method (FEM). The window remeshing technique has been proposed where a crack may propagate in an arbitrary direction with an arbitrary length of extension inside the window. To reproduce the intended singularity in the vicinity of the crack tip, Quarter Point Elements (QPE) have been employed because of their simplicity and accuracy. To reduce spatially induced errors, a scheme consisting of determining the cutoff frequency using a simple energy criterion and digital filter using Fast Fourier Transform (FFT) is proposed. A unified boundary damping technique is used. At each stage of remeshing, nodal quantity vector interpolation must be done before subsequent iterations in time-space can be executed. The numerical determination of the resulting inverse mapping is presented. Due to the strategy adopted in the window remeshing technique and the dynamic FEM constraints, the resultant mesh must be further verified by a preanalyzer developed after each remeshing. This preanalyzer (ADFEP) is written using algorithms based on graph theory. Author

**N88-18967*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STRUCTURAL ANALYSIS METHODS DEVELOPMENT FOR TURBINE HOT SECTION COMPONENTS**
Robert L. Thompson [1988] 38 p Prepared for presentation at the International Gas Turbine and Aerospace Congress, Amsterdam, The Netherlands, 5-9 Jun. 1988; sponsored by ASME
(NASA-TM-100298; E-3926; NAS 1.15:100298) Avail: NTIS HC A03/MF A01 CSCL 20K

The structural analysis technologies and activities of the NASA Lewis Research Center's gas turbine engine Hot Section Technology (HOST) program are summarized. The technologies synergistically developed and validated include: time-varying thermal/mechanical load models; component-specific automated geometric modeling and solution strategy capabilities; advanced inelastic analysis methods; inelastic constitutive models; high-temperature experimental techniques and experiments; and nonlinear structural analysis codes. Features of the program that incorporate the new technologies and their application to hot section component analysis and design are described. Improved and, in some cases, first-time 3-D nonlinear structural analyses of hot section components of isotropic and anisotropic nickel-base superalloys are presented. Author

**N88-18968*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STRUCTURE OF A VISCOPLASTIC THEORY**
Alan D. Freed [1988] 27 p Prepared for presentation at the Summer Annual Meeting Symposium on Constitutive Equations and Life Prediction Models for High Temperature Applications, Berkeley, Calif., 20-22 Jun. 1988; sponsored by ASME
(NASA-TM-100794; E-3969; NAS 1.15:100794) Avail: NTIS HC A03/MF A01 CSCL 20L

The general structure of a viscoplastic theory is developed from physical and thermodynamical considerations. The flow equation is of classical form. The dynamic recovery approach is shown to be superior to the hardening function approach for incorporating nonlinear strain hardening into the material response through the evolutionary equation for back stress. A novel approach for introducing isotropic strain hardening into the theory is presented, which results in a useful simplification. In particular, the limiting stress for the kinematic saturation of state (not the

drag stress) is the chosen scalar-valued state variable. The resulting simplification is that there is no coupling between dynamic and thermal recovery terms in each evolutionary equation. The derived theory of viscoplasticity has the structure of a two-surface plasticity theory when the response is plasticlike, and the structure of a Bailey-Orowan creep theory when the response is creeplike.
Author

**N88-18969*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE EFFECTS OF ROTATIONAL FLOW, VISCOSITY, THICKNESS, AND SHAPE ON TRANSONIC FLUTTER DIP PHENOMENA**
T. S. R. Reddy, Rakesh Srivastava (Georgia Inst. of Tech., Atlanta.), and Krishna Rao V. Kaza [1988] 21 p Prepared for presentation at the 29th Structures, Structural Dynamics and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988; sponsored in part by AIAA, ASME, ASCE, and AHS
(Grants NsG-3139; NAG3-370)
(NASA-TM-100811; E-3993; AIAA-88-2348; NAS 1.15:100811)
Avail: NTIS HC A03/MF A01 CSCL 20K

The transonic flutter dip phenomena on thin airfoils, which are employed for propfan blades, is investigated using an integrated Euler/Navier-Stokes code and a two degrees of freedom typical section structural model. As a part of the code validation, the flutter characteristics of the NACA 64A010 airfoil are also investigated. In addition, the effects of artificial dissipation models, rotational flow, initial conditions, mean angle of attack, viscosity, airfoil thickness and shape on flutter are investigated. The results obtained with a Euler code for the NACA 64A010 airfoil are in reasonable agreement with published results obtained by using transonic small disturbance and Euler codes. The two artificial dissipation models, one based on the local pressure gradient scaled by a common factor and the other based on the local pressure gradient scaled by a spectral radius, predicted the same flutter speeds except in the recovery region for the case studied. The effects of rotational flow, initial conditions, mean angle of attack, and viscosity for the Reynold's number studied seem to be negligible or small on the minima of the flutter dip. Author

**N88-18970*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DEFORMATIONS IN VLBI ANTENNAS**
T. A. Clark and P. Thomsen (Interferometrics, Inc., Vienna, Va.) Jan. 1988 96 p
(NASA-TM-100696; Rept-88B0090; NAS 1.15:100696) Avail: NTIS HC A05/MF A01 CSCL 20K

A study is presented of deformations in antennas with the emphasis on their influence on VLBI measurements. The GIFTS structural analysis program has been used to model the VLBI antenna in Fairbanks (Alaska). The report identifies key deformations and studies the effect of gravity, wind, and temperature. Estimates of expected deformations are given.
Author

**N88-18971*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
**EFFECT OF ELEMENT SIZE ON THE SOLUTION ACCURACIES OF FINITE-ELEMENT HEAT TRANSFER AND THERMAL STRESS ANALYSES OF SPACE SHUTTLE ORBITER**
William L. Ko and Timothy Olona Aug. 1987 51 p Presented at the 5th International Conference on Numerical Methods in Thermal Problems, Montreal, Quebec, 24 Jun. - 3 Jul. 1987
(NASA-TM-88292; H-1409; NAS 1.15:88292) Avail: NTIS HC A04/MF A01 CSCL 20K

The effect of element size on the solution accuracies of finite-element heat transfer and thermal stress analyses of space shuttle orbiter was investigated. Several structural performance and resizing (SPAR) thermal models and NASA structural analysis (NASTRAN) structural models were set up for the orbiter wing midspan bay 3. The thermal model was found to be the one that determines the limit of finite-element fineness because of the limitation of computational core space required for the radiation view factor calculations. The thermal stresses were found to be extremely sensitive to a slight variation of structural temperature distributions. The minimum degree of element fineness required for the thermal model to yield reasonably accurate solutions was established. The radiation view factor computation time was found to be insignificant compared with the total computer time required for the SPAR transient heat transfer analysis. Author

**N88-18972#** GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Werkstofforschung.
**COMPARATIVE INVESTIGATIONS OF INDIRECT CRACK LENGTH MEASUREMENT UNDER FATIGUE LOADING IN A CORROSIVE ENVIRONMENT [VERGLEICHENDE UNTERSUCHUNGEN ZUR INDIREKTEN MESSUNG DER RISSLAENGE BEI SCHWINGENDER BELASTUNG IN KORROSIVER UMGEBUNG]**
B. Wellenkoetter, M. Horstmann, and K.-H. Schwalbe 1986 13 p In GERMAN Presented at a conference, Bad Nauheim, Fed. Republic of Germany, 27-28 Nov. 1986
(GKSS-86/E/64; ISSN-0344-9629; ETN-88-91455) Avail: NTIS HC A03/MF A01

The dc potential method, ac current method, and the compliance method for indirect crack length determination were confronted, and their results were compared with the optically determined crack lengths. The fundamentals of the three methods are explained. Compact specimens made of StE 420M steel were tested under different circumstances. The results show that the ac current method is suited for the indirect crack length measurements in a corrosive environment, in the Paris as well as in the threshold loading range. It is therefore suited for computer controlled testing. The compliance method is only conditionally suited for crack length determination, but is suited for the measurement of the crack closure. ESA

**N88-18973#** GKSS-Forschungszentrum Geesthacht (West Germany).
**DETERMINATION OF THE ELASTIC-PLASTIC FRACTURE TOUGHNESS PARAMETERS UNDER SPECIAL CONSIDERATION OF THE ACTIVITIES OF THE EUROPEAN GROUP ON FRACTURE (EGF) [ERMITTLUNG VON ELASTISCH-PLASTISCHEN RISSZAEHIGKEITSPARAMETERN UNTER RESONDERER BERUECKSICHTIGUNG DER AKTIVITAETEN DER EGF]**
K.-H. Schwalbe, B. K. Neale (Central Electricity Generating Board, Berkeley, England ), and I. Ingham 1987 27 p In GERMAN Presented at a conference, Freiburg, Fed. Republic of Germany, 16-18 Mar. 1987
(GKSS-87/E/30; ISSN-0344-9629; ETN-88-91457) Avail: NTIS HC A03/MF A01

The development of a materials testing procedure in nonlinear fracture mechanics is discussed. The definitions of crack initiation are explained, and the different test methods are presented. A uniform fracture mechanics test standard is considered. The procedure is based on the multiple specimen method and uses bending and tensile specimens. The J and delta evaluation formulas and their domain of validity are presented. The proposed procedure describes the determination of three crack initiation parameters used for materials characterization or for the evaluation of components. ESA

**N88-18974*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CHARACTERIZATION OF DAMPED STRUCTURAL CONNECTIONS FOR MULTI-COMPONENT SYSTEMS**
Charles Lawrence and Arthur A. Huckelbridge (Case Western Reserve Univ., Cleveland, Ohio.) Mar. 1988 19 p
(NASA-TM-100801; E-3980; NAS 1.15:100801) Avail: NTIS HC A03/MF A01 CSCL 20K

The inability to model connections adequately has historically limited the ability to predict overall system dynamic response. Connections between structural components are often mechanically complex and difficult to accurately model analytically. Improved analytical models for connections are needed to improve system

dynamic predictions. This study explores combining Component Mode Synthesis methods for coupling structural components with Parameter Identification procedures for improving the analytical modeling of the connections. Improvements in the connection stiffness and damping properties are computed in terms of physical parameters so the physical characteristics of the connections can be better understood, in addition to providing improved input for the system model. Author

**N88-18975*#** Cleveland State Univ., Ohio.
**RELIABILITY BASED ANALYSIS OF CONTACT PROBLEMS Final Contractor Report**
Lynn M. Powers and Louis J. Ghosn Mar. 1988 8 p Proposed for presentation at the Probabilistic Methods Conference, Blacksburg, Va., 25-27 May 1988; sponsored by the American Society of Civil Engineering
(Contract NCC3-46)
(NASA-CR-182117; E-4007; NAS 1.26:182117) Avail: NTIS HC A02/MF A01 CSCL 20K

The Batdorf model is modified to include the reduction in shear due to the effect of compressive stresses on the crack face. This new formulation was used to obtain the probability of failure of ceramic components under contact stress conditions. The combined effect of the surface and volume flaws are included in the analysis. Due to the nature of the fracture of brittle materials under compressive loading, the component is modeled as a series system in order to establish bounds on the probability of failure. Author

**N88-18976*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A SEMIANALYTICAL TECHNIQUE FOR SENSITIVITY ANALYSIS OF UNSTEADY AERODYNAMIC COMPUTATIONS**
Durbha V. Murthy (Toledo Univ., Ohio.) and Krishna Rao V. Kaza 1988 24 p Presented at the 29th Structures, Structural Dynamics and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988; sponsored by AIAA, ASME, ASCE, AHS and ACS
(NASA-TM-100810; E-3990; NAS 1.15:100810; AIAA-88-2377)
Avail: NTIS HC A03/MF A01 CSCL 20K

A semianalytical approach is developed for the sensitivity analysis of linear unsteady aerodynamic loads. The semianalytical approach is easier to implement than the analytical approach. It is also computationally less expensive than the finite difference approach when used with panel methods, which require a large number of panels. The semianalytical approach is applied to an isolated airfoil in a 2-D flow and rotating propfan blades in 3-D flow. Sensitivity coefficients with respect to non-shape-dependent variables are shown for some cases. It is expected that the semianalytical approach will be useful in aeroelastic design procedures particularly when mistuning is present, and that it is potentially useful for shape sensitivity analysis of linear unsteady aerodynamics. Author

**N88-18636#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strukturmechanik.
**DAMAGE MECHANISMS OF CFRP RIVETED JOINTS**
Dirk Wetzel *In its* Colloquium on Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Jun. 1987 p 189-209 In GERMAN; ENGLISH summary (For primary document see N88-18630 11-24)
Avail: NTIS HC A11/MF A01; DFVLR, Cologne, Fed. Republic of Germany DM 79

# 42 GEOSCIENCES (GENERAL)

**N88-18977#** Air Force Geophysics Lab., Hanscom AFB, Mass.
**AFGL (AIR FORCE GEOPHYSICS LABORATORY) FISCAL YEAR 1988 AIR FORCE TECHNICAL OBJECTIVES DOCUMENT Annual Special Report, Oct. 1987 - Sep. 1988**
Oct. 1987 42 p
(AD-A187701; AFGL-TR-87-0088; AFGL-SR-255) Avail: NTIS HC A03/MF A01 CSCL 04A

The Technical Objective Document (TOD) provides relevant planning information on AFGL's FY88 Research and Technology programs. AFGL conducts programs in the areas of the space environment, ionospheric effects, optical and infrared environment, infrared surveillance technology, the atmospheric science and terrestrial effects. Author

# 43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

**N88-18978#** Defense Mapping Agency Aerospace Center, St. Louis, Mo.
**THE DIGITAL LANDMASS SIMULATION PRODUCTION OVERVIEW**
Richard V. Halbert 1987 8 p
(AD-A187978) Avail: NTIS HC A02/MF A01 CSCL 08B

The Defense Mapping Agency (DMA) pioneered in the development and production of Digital Landmass (DLMS) data to support various simulation systems for operational training. A variety of production techniques, procedures, software, and equipment have been developed by DMA since 1977. The Agency is currently responsible for the publication and distribution of product specifications for DLMS data and is also responsible for Multination agreement establishing standardized production and exchange of DLMS data. This presentation explores some of this production methodology. While not an historical treatment of the subject, production and methodology will be discussed in an evolutionary context. Finally, the presentation will explore some future considerations involving further evolution of the production methodology as well as comment on anticipated changes to the nature of DLMS data. GRA

**N88-18979#** Naval Postgraduate School, Monterey, Calif.
**THREE-DIMENSIONAL IMAGE GENERATION FROM AN AERIAL PHOTOGRAPH M.S. Thesis**
Leland G. Coleman Sep. 1987 106 p
(AD-A188039) Avail: NTIS HC A06/MF A01 CSCL 08B

This thesis concerns developing a program that takes an aerial photograph, and a set of Digital Terrain Elevation Data (DTED) that is defined over the area of the photograph, and generates a synthesized view that represents what a camera would see from a different location. The elevation data points are grouped into triangular panels that are projected to the reference image by three dimensional transformation equations. Shading for the synthesized image is determined from the reference image. The pixels of the reference image that fall within a triangular panel are collected and averaged. When a new observer location is selected, the panels are projected to the new synthesized image plane. A z-buffer approach and a polygon fill algorithm were used to remove hidden surfaces of the synthesized view. This program is tested on both artificial and real data. Other characteristics and performance measurements of the program are also analyzed here. The quality of the synthesized image from real data was affected by the low resolution of the terrain elevation data, and yielded less desirable results then could be expected of a high resolution. GRA

**N88-18980#** Army Engineer Topographic Labs., Fort Belvoir, Va.
**CONTOUR-TO-GRID INTERPOLATION WITH NONLINEAR FINITE ELEMENTS: A FEASIBILITY STUDY Technical Report, Jan. 1986 - Sep. 1986**
Betty Mandel, Javier Bernal, and Christoph Witzgall Sep. 1987 74 p

(AD-A188108; ETL-0472) Avail: NTIS HC A04/MF A01 CSCL 08B

This report concludes the second phase of a three-phase collaborative effort between the U.S. Army Engineer Topographic Laboratories and the National Bureau of Standards. The main objective of this effort is to develop and implement a contour-to-grid algorithm, that is, an algorithm capable of converting digitized contour data into Digital Terrain Elevation Data (DTED). The approach is to create a synthetic terrain surface based on digitized contour information and then to calculate any grid from that surface. Five tasks are to be performed: (1) edit a digitized contour data set (input); (2) thin (reduce, sample) the input data; (3) triangulate the selected points; (4) generate a smooth synthetic surface; and (5) generate the desired grid. The first phase, which was completed in December 1985, addressed the first three tasks. The second phase, to which this report refers, elaborates on the previous results and includes work in all five areas. The effort demonstrates the feasibility of performing such tasks for large data sets, such as a Digital Graphic Recorder data tape of roughly 500,000 points. GRA

**N88-18981#** Army Engineer Topographic Labs., Fort Belvoir, Va.

**TERRAIN ANALYST WORK STATION (TAWS) DEMONSTRATIONS**

Mark A. Sither 16 Dec. 1986 10 p

(AD-A188139; USAETL-R-108) Avail: NTIS HC A02/MF A01 CSCL 08B

The Terrain Analyst Work Station (TAWS) project was initiated by the U.S. Army Engineer Topographic Laboratories (USAETL) to develop a prototype system to meet the Army's requirements for providing accurate and timely terrain and environmental information used in making critical military planning and operational decisions. TAWS is designed for use by Army terrain analysts and is being demonstrated in the laboratory and in conjunction with a series of Army Field exercises. During each field demonstration, soldiers are trained in the functional operations of the system and allowed to test its capabilities for digital terrain data extraction, analysis manipulation, and synthesized product generation with minimum supervision by USAETL personnel. Test and demonstration results as well as feedback from various Army elements involved in each exercise are designed to assist scientists and engineers in the development of requirements and specifications for future Army digital topographic support. GRA

**N88-18982#** Army Engineer Topographic Labs., Fort Belvoir, Va.

**THE QUICK RESPONSE MULTICOLOR PRINTER (QRMP) SYSTEM**

Guy M. Hardaway 28 Sep. 1987 5 p

(AD-A188140; USAETL-R-111; USAETL-R-113) Avail: NTIS HC A02/MF A01 CSCL 14E

The Quick Response Multicolor Printer (QRMP), which has recently completed the 6.3 development phase, uses laser-xerography to produce full-size process color reproductions of tomographic products. Copies can be produced from color map or chart originals, transparencies, and a yet to be defined digital data file. With scanning resolutions of 400 to 800 lines per inch, the QRMP can be configured to operate in a reproduction, facsimile, or a digital mode. This paper will briefly describe the Operational and Organizational plan for the QRMP's deployment, QRMP system characteristics, how the QRMP works, the Program Schedule, and the anticipated Operational Improvements when the QRMP is deployed. GRA

**N88-18983#** Army Engineer Topographic Labs., Fort Belvoir, Va.

**RADAR DESCRIPTORS FOR THE CLASSIFICATION OF TERRAIN FEATURES**

Frederick W. Rohde 16 Sep. 1987 17 p

(AD-A188145; USAETL-R-109) Avail: NTIS HC A03/MF A01 CSCL 17I

An approach toward the automated extraction of terrain features from synthetic aperture radar (SAR) imagery is the development of sets of descriptors that uniquely and unambiguously characterize each feature. This investigation involves a detailed examination of 701 SAR image examples covering 29 types of man-made and natural terrain features. The descriptors represent attributes of the radar signatures from terrain features. The descriptors are developed by means of which image analysts identify the terrain features. The development of descriptors is guided by the objectives that the descriptors can be easily recognized and identified by untrained personnel and that they provide a baseline for interactive and automated feature extraction. The number of selected descriptors at this point is 52 and may change as the research progresses. A feature class is characterized by specific sets of descriptors. Because radar signatures of the same type of terrain feature will vary it is necessary to establish combination rules for descriptor sets. GRA

**N88-18984*#** Cornell Univ., Ithaca, N.Y. Dept. of Geological Sciences.

**THEMATIC MAPPER STUDY OF ALASKAN OPHIOLITES Final Report**

John M. Bird Feb. 1988 296 p

(Contract NAS5-28739)

(NASA-CR-182554; NAS 1.26:182554) Avail: NTIS HC A13/MF A01 CSCL 08G

The two principle objectives of the project Thematic Mapper Study of Alaskan Ophiolites were to further develop techniques for producing geologic maps, and to study the tectonics of the ophiolite terrains of the Brooks Range and Ruby Geanticline of northern Alaska. Ophiolites, sections of oceanic lithosphere emplaced along island arcs and continental margins, are important to the understanding of mountain belt evolution. Ophiolites also provide an opportunity to study the structural, lithologic, and geochemical characteristics of ocean lithosphere, yielding a better understanding of the processes forming lithosphere. The first part of the report is a description of the methods and results of the TM mapping and gravity modeling. The second part includes papers being prepared for publication. These papers are the following: (1) an analysis of basalt spectral variations; (2) a study of basalt geochemical variations; (3) an examination of the cooling history of the ophiolites using radiometric data; (4) an analysis of shortening produced by thrusting during the Brooks Range orogeny; and (5) a study of an ophiolite using digital aeromagnetic and topographic data. Additional papers are in preparation. F.M.R.

**N88-18985** New South Wales Univ., Kensington (Australia). School of Electrical Engineering and Computer Science.

**MULTISOURCE CONTEXT CLASSIFICATION METHODS IN REMOTE SENSING Abstract Only. Ph.D. Thesis**

Tong Lee Oct. 1986 264 p

Avail: Issuing Activity

The problem of multisource data analysis in remote sensing is concerned with the extraction of information embodied in different sources of spatial data to allow a composite decision to be made concerning the class membership of pixels in the data. Methodologies for solving this problem were in the past mostly ad hoc, and only little attention was given to deriving means for machine-assisted or semi-automated analysis of multisensor and multisource spatial data. Two approaches, one probabilistic and the other evidential, are described for addressing this important problem. The concepts developed in both multisource classification approaches are evaluated with LANDSAT image data and the results demonstrate their effectiveness. An essential feature common to both approaches is the ability to incorporate uncertainties regarding the data and analysis qualities into the process of making composite inferences, a property not shared with other established techniques. Author

**N88-18986** New South Wales Univ., Kensington (Australia).

**SURVEYING WITH GPS IN AUSTRALIA Abstract Only. Ph.D. Thesis**

Rod Eckels Nov. 1986 222 p
Avail: Issuing Activity

This thesis describes the Global Positioning System (GPS) and how it can be used for surveying in Australia. The basic component parts of the system and the role they play are outlined. The satellite signal measurement process is described and currently available receivers are reviewed. Field procedures and processing techniques that should be followed to achieve surveying accuracies are discussed. As GPS surveys refer to a satellite reference datum, the relationship between this datum and the Australian datum is given. With the knowledge about GPS provided here, the surveyor should be able to use GPS confidently. Author

**N88-18987#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**A DIGITAL TERRAIN SYSTEM FOR MICROCOMPUTERS [UM SISTEMA DIGITAL DE TERRENO PARA MICROCOMPUTADORES]**

Carlos Alberto Felgueiras, Guaraci Jose Erthal, Luiz Albert Vieira Dias, Joao Argemiro C. Paiva, and Gilberto Camara Neto May 1987 8 p In PORTUGUESE; ENGLISH summary Presented at the 14th Integrated Software and Hardware Seminar, Salvador, Bahia, 11-19 Jul. 1987
(INPE-4170-PRE/1067) Avail: NTIS HC A02/MF A01

This paper describes theoretical and implementation features of a Digital Terrain Modeling System (DTM). This system runs on a microcomputer and is integrated with a Geographic Information System which allows the combination of DTM data with thematics maps, satellite images, and so on, to obtain new derived maps. Author

**N88-18988#** Bureau of Mines, Pittsburgh, Pa. Research Center.

**CHARACTER OF FIVE SELECTED LANDSAT LINEAMENTS IN SOUTHWESTERN PENNSYLVANIA: REPORT OF INVESTIGATIONS, 1987**

N. N. Moebs and G. P. Sames 1987 31 p
(PB88-133517; BM-RI-9104; LC-86-607593) Avail: NTIS HC A03/MF A01 CSCL 05B

Five LANDSAT lineaments in the coal mining region of southwestern Pennsylvania were investigated by the Bureau of Mines to determine their geologic character, relation to subsurface conditions, and the means of discriminating one from another. The investigation included earth resistivity and very low frequency electromagnetic traverses, soil moisture sampling, and a correlation with coal mine roof conditions. The lineaments could not be detected by the methods used, suggesting that they might be a surface phenomenon unrelated to subsurface geologic structures or roof stability in coal mine workings beneath. GRA

**N88-18989#** New Mexico Inst. of Mining and Technology, Socorro.

**LAYERED-CAPACITOR METHOD FOR DIELECTRIC BRIDGE MEASUREMENTS. ALGORITHMS FOR INVERSION AND PARAMETER FITTING: DOCUMENTATION, VERIFICATION, DATA ANALYSIS Final Report, 15 Nov. 1983 - 30 Oct. 1986**

G. W. Gross and R. M. McGehee 25 Jun. 1987 178 p
(Grants NSF ATM-80-16516; NSF ATM-83-11107)
(PB88-131479) Avail: NTIS HC A09/MF A01 CSCL 08L

Electrical properties of ice are of interest in the analysis of cloud processes (especially those related to the build-up of electric fields in thunderstorms) and of polar ice soundings. To quantify electrical ice properties and to assess possible effects of atmospheric trace contaminants, capacitance and conductance are measured in function of frequency, temperature, and trace solute content. In the frequency range of interest (0.01 Hz to 100 kHz) electrode effects mask intrinsic ice properties. These problems, common to conductive dielectrics, are avoided in the layered capacitor method by inserting thin layers of a perfect insulator between electrodes and samples. Instrumental improvements have increased bridge measurement accuracy and frequency range. New algorithms are based on a generalized physical model. The methodology developed provides a basis for systematic investigation of contaminant effects on the electrical properties of ice and of other conductive dielectrics. Author

**N88-18990#** Oak Ridge National Lab., Tenn.

**GEOPHYSICAL DIFFRACTION TOMOGRAPHY FOR IMAGING ISOLATED SUBSURFACE INCLUSIONS**

A. J. Witten and W. C. King 1988 19 p Presented at the Tunnel Detection Symposium, Golden, Colo., 12 Jan. 1988 Prepared in cooperation with Tennessee Univ., Knoxville
(Contract DE-AC05-84OR-21400)
(DE88-003918; CONF-880140-1) Avail: NTIS HC A03/MF A01

Progress is reported in developing a fieldable geophysical diffraction tomography system, including the development of a data acquisition system capable of resolving the necessary wave characteristics, in-field real time signal processing, and image reconstruction software development. Geophysical diffraction tomography is a technique for high resolution, quantitative imaging of subsurface cross-sections. The method is based on an imaging process known as filtered backpropagation which is a generalization of the inverse straight ray tracing process referred to as backprojection. In backpropagation, an image of the spatial variations in refractive index is formed by backpropagating, by means of the reduced wave equation, data received along an array of detectors from this array into the support volume of the host medium. Important steps in this imaging process include the synthesis of a coherent incident wave, the determination of complex phase perturbations relative to a homogeneous background, and the numerical application of a holographic lens. Using a seismic signal this method is capable of detecting and imaging subsurface features possessing material properties different from the surrounding medium. DOE

**N88-18991#** Los Alamos National Lab., N. Mex.

**THE ANGULAR REFLECTANCE SIGNATURE OF THE CANOPY HOT SPOT IN THE OPTICAL REGIME**

S. A. W. Gerstl 1988 5 p Presented at the 4th International Colloquium on Spectral Signatures of Objects in Remote Sensing, Aussois, France, 18 Jan. 1988
(Contract W-7405-eng-36)
(DE88-005385; LA-UR-88-145; CONF-880154-1) Avail: NTIS HC A02/MF A01

When any three-dimensional surface, e.g., a plant canopy is illuminated by a directional light source such as the sun, an angular reflectance distribution results that shows a narrow intensity peak in the direction of retro-reflection. This is called the Heiligenschein or hot spot (HS) of vegetation canopies and is caused by the absence of mutual shading of leaves when the observation direction coincides with the illumination direction. The angular intensity distribution of this hot spot, its brightness and contrast against the background, are therefore indicators of the plant's geometry. We show from experimental data and by modeling that the hot spot angular reflectance signature carries information about plant stand architecture that is often more distinctive for different plant species than their spectral signatures. DOE

**N88-18992#** Sandia National Labs., Albuquerque, N. Mex.

**TARGET-REFLECTIVITY MODELS FOR VARIOUS TERRAIN TYPES**

G. K. Froehlich Jan. 1988 20 p
(Contract DE-AC04-76DP-00789)
(DE88-005510; SAND-87-2871) Avail: NTIS HC A03/MF A01

In the first section of this report, measured data are used to calculate Fresnel-reflection coefficients for several terrain types. In the next section, scattering-terrain models are fit to the same data. In the third and final section, the author uses the parameters of the scattering-terrain models to find equivalent Fresnel-reflection coefficients; these are compared to those found in the first section, thus serving as a measure of the applicability of the models. DOE

**N88-18993#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
**REPORTS ON CARTOGRAPHY AND GEODESY. SERIES 1, REPORT 98 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: HEFT 98]**
1987 105 p In GERMAN; ENGLISH summary
(ISSN-0469-4236; ETN-88-91098) Avail: NTIS HC A06/MF A01

The significance of orientation unknowns in station and net adjustments was treated. The application of Global Positioning System time receivers to the fundamental station Wettzell is presented. The datum problem of global networks, determined by satellite techniques, was investigated. For individual titles, see N88-18994 through N88-18996.

**N88-18994#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
**THE SIGNIFICANCE OF ORIENTATION UNKNOWNS IN STATION AND NET ADJUSTMENTS [DIE BEDEUTUNG DER ORIENTIERUNGSUNBEKANNTEN IN STATIONS- UND NETZAUSGLEICHUNGEN]**
Dieter Ehlert *In its* Reports on Cartography and Geodesy. Series 1, Report 98 1987 p 5-86 In GERMAN; ENGLISH summary
(For primary document see N88-18993 11-43)
Avail: NTIS HC A06/MF A01

It is demonstrated that the weight matrices of a station-adjusted set of directions are not uniquely defined by the observed values, so that there exists a variety of weight matrices, equivalent with respect to the net adjustment. Formulas to transform these matrices into each other are given. Using singular weight matrices a system of normal equations free of orientation unknowns can be set up for net adjustment. The Cholesky decomposition of the weight matrices provides the stochastically correct transition from directions to systems of angles with common reference directions and of adjacent angles. The weight matrices correspond to equivalent variance-covariance matrices that are also interconnected by transformation formulas. The relations between these formulas and those of the weight matrice were derived. It is shown when correlation-free or weakly correlated station-adjusted directions can be expected. ESA

**N88-18995#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
**APPLICATION OF THE GLOBAL POSITIONING SYSTEM (GPS) TIME RECEIVERS TO THE FUNDAMENTAL STATION WETTZELL [ZUM EINSATZ VON GPS-ZEITEMPFAENGERNAUF DER FUNDAMENTALSTATION WETTZELL]**
Wolfgang Schlueter *In its* Reports on Cartography and Geodesy. Series 1, Report 98 1987 p 87-95 In GERMAN; ENGLISH summary (For primary document see N88-18993 11-43)
Avail: NTIS HC A06/MF A01

The first experiences with two GPS receivers for time transfer are presented. The GPS that works presently with seven operational satellites is described. Test measurements show that time transfer between stations with a precision of better than 20nsec is possible, if the common view technique is applied and if the receivers are calibrated ESA

**N88-18996#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
**THE ORIENTATION OF GLOBAL SATELLITE NETWORKS [ZUR ORIENTIERUNG VON GLOBALEN SATELLITENNETZEN]**
Gerhard Soltau *In its* Reports on Cartograhy and Geodesy. Series 1, Report 98 1987 p 95-105 In GERMAN; ENGLISH summary (For primary document see N88-18993 11-43)
Avail: NTIS HC A06/MF A01

The datum problem of global networks, determined by satellite techniques, is treated. The conditions for the derivation of the Bender-Goad formulas for the orientation of global networks are given. It is shown that these can be derived on the basis of the fictitious transformation of Reissmann. The datum problem can be removed by a combination of the adjustment of the measured value and a Helmert coordinate transformation to a compatible approximation system. ESA

**N88-18997#** National Oceanic and Atmospheric Administration, Washington, D. C. Satellite Research Lab.
**GENERAL DETERMINATION OF EARTH SURFACE TYPE AND CLOUD AMOUNT USING MULTISPECTRAL AVHRR DATA**
Irwin Ruff and Arnold Gruber Feb. 1988 36 p
(NOAA-TR-NESDIS-39) Avail: NTIS HC A03/MF A01

A method is presented for determining the type of daylight scene viewed by every resolution element of the Advanced Very High Resolution Radiometer (AVHRR) for routine, large-scale processing, using mainly values from the various spectral channels of AVHRR. The specification of scene types was restricted to the broad categories of vegetation, non-vegetated land, snow/ice, and cloud. The method appears to be sufficiently sensitive, however, to permit it to be extended to finer specification of scene type. Author

# 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

**N88-18998#** Midwest Research Inst., Golden, Colo.
**STATUS OF THE SPECIAL-PURPOSE AIRFOIL FAMILIES**
J. L. Tangler and D. M. Somers Dec. 1987 9 p Presented at Windpower '87, San Francisco, Calif., 5 Oct. 1987 Prepared in cooperation with Airfoils, Inc., Hampton, Va.
(Contract DE-AC02-83CH-10093)
(DE88-001124; SERI/TP-217-3264; CONF-871062-9) Avail: NTIS HC A02

This work is directed at developing thin and thick airfoil families, for rotors with diameters of 10 to 30 m, that enhance energy output at low to medium wind speeds and provide more consistent operating characteristics with lower fatigue loads at high wind speeds. Performance is enhanced through the use of laminar flow, while more consistent rotor operating characteristics at high wind speeds are achieved by tailoring the airfoil such that the maximum lift coefficient C sub 1 max is largely independent of roughness effects. Using the Eppler airfoil design code, two thin and one thick airfoil family were designed; each family has a root, outboard, and tip airfoil. Two-dimensional wind-tunnel tests were conducted to verify the predicted performance characteristics for both a thin and thick outboard airfoil from these families. Atmospheric tests on full-scale wind turbines will complete the verification process. DOE

**N88-18999#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**DESIGN FEATURES OF SMALL BRAYTON CYCLES FOR AUTONOMOUS UNDERWATER VEHICLES M.S. Thesis**
Katherine A. Sydnor Jun. 1987 93 p
(Contract N00228-85-G-3262)
(AD-A187799) Avail: NTIS HC A05/MF A01 CSCL 13J

Several alternative power systems are being considered for small autonomous submersibles to meet long duration and high speed operations. The closed cycle Brayton engine using lithium sulfur hexafluoride as the energy source is one of the more promising systems. A small closed cycle Brayton engine has been evaluated utilizing components which have been tested for space applications. Modifications were made to optimize the unit for the undersea vehicle. Computer programs were developed to facilitate this process. It was concluded that a 2 kilowatt Brayton cycle engine would occupy 50 inches of length in a 21 inch diameter space and 36 inches in a 25 inch diameter space. GRA

**N88-19000*#** Clarkson Univ., Potsdam, N.Y. Dept. of Electrical and Computer Engineering.
**COMPUTER-AIDED MODELING AND PREDICTION OF PERFORMANCE OF THE MODIFIED LUNDELL CLASS OF ALTERNATORS IN SPACE STATION SOLAR DYNAMIC POWER SYSTEMS Semiannual Progress Report, 15 Aug. 1987 - 14 Feb. 1988**
Nabeel A. O. Demerdash and Ren-hong Wang 15 Mar. 1988 62 p
(Grant NAG3-818)
(NASA-CR-182538; NAS 1.26:182538) Avail: NTIS HC A04/MF A01 CSCL 10B

The main purpose of this project is the development of computer-aided models for purposes of studying the effects of various design changes on the parameters and performance characteristics of the modified Lundell class of alternators (MLA) as components of a solar dynamic power system supplying electric energy needs in the forthcoming space station. Key to this modeling effort is the computation of magnetic field distribution in MLAs. Since the nature of the magnetic field is three-dimensional, the first step in the investigation was to apply the finite element method to discretize volume, using the tetrahedron as the basic 3-D element. Details of the stator 3-D finite element grid are given. A preliminary look at the early stage of a 3-D rotor grid is presented. J.P.B.

**N88-19001#** Oak Ridge National Lab., Tenn. Engineering Technology Div.
**DEVELOPMENT OF ENCAPSULATED LITHIUM HYDRIDE THERMAL ENERGY STORAGE FOR SPACE POWER SYSTEMS**
D. G. Morris, J. P. Foote, and M. Olszewski Dec. 1987 97 p
(Contract DE-AC05-84OR-21400)
(DE88-004762; ORNL/TM-10413) Avail: NTIS HC A05/MF A01

Inclusion of thermal energy storage in a pulsed space power supply will reduce the mass of the heat rejection system. In this mode, waste heat generated during the brief high-power burst operation is placed in the thermal store; later, the heat in the store is dissipated to space via the radiator over the much longer nonoperational period of the orbit. Thus, the radiator required is of significantly smaller capacity. Scoping analysis indicates that use of lithium hydride as the thermal storage medium results in system mass reduction benefits for burst periods as long as 800 s. A candidate design for the thermal energy storage component utilizes lithium hydride encapsulated in either 304L stainless steel or molybdenum in a packed-bed configuration with a lithium or sodium-potassium (NaK) heat transport fluid. Key issues associated with the system design include phase-change induced stresses in the shell, lithium hydride and shell compatibility, lithium hydride dissociation and hydrogen loss from the system, void presence and movement associated with the melt-freeze process, and heat transfer limitations on obtaining the desired energy storage density. DOE

**N88-19002#** Pacific Northwest Labs., Richland, Wash.
**CARIBBEAN AND CENTRAL AMERICA WIND ENERGY ASSESSMENT**
D. L. Elliott Oct. 1987 9 p Presented at Windpower '87, San Francisco, Calif., 5 Oct. 1987
(Contract DE-AC06-76RL-01830)
(DE88-005134; PNL-SA-15102; CONF-871062-11) Avail: NTIS HC A02/MF A01

A wind energy resource assessment of the Caribbean and Central America, based on available data and using innovative assessment techniques developed for this region, has identified many areas with good to outstanding wind resource potential. This paper provides an overview of the Caribbean an Central America wind resource assessment and the data and techniques used in producing the assessment. Wind resource maps were developed for 35 island/country areas throughout the Caribbean and Central America. These maps highlight the locations of major resource areas and provide not only estimates of the wind energy resource potential for well-exposed sites in these areas, but also information on the frequency distribution of the wind speeds (expressed as estimates of the Weibull shape factor, k) and seasonal variations in the wind resource. The average energy in the wind flowing in the layer near the ground is expressed as a wind power class: the greater the average wind energy, the higher the wind power class. A diagram was developed for easily relating the wind power classes and Weibull k values to values of mean wind power density and mean wind speed. DOE

**N88-19003#** Pacific Northwest Labs., Richland, Wash.
**SITE EFFECTS ON WIND CHARACTERISTICS AT A TURBINE ROTOR**
J. R. Connell, D. C. Powell, and V. R. Morris Oct. 1987 7 p Presented at Windpower '87, San Francisco, Calif., 5 Oct. 1987
(Contract DE-AC06-76RL-01830)
(DE88-005135; PNL-SA-15103; CONF-871062-12) Avail: NTIS HC A02/MF A01

Enough measurements of wind characteristics at two different types of turbine sites have now been completed to support a useful preliminary description of the effect of a site on the wind. This paper discusses the effect of terrain, with minimal reference to atmospheric static stability and other processes, on the wind at two sites. The turbulent wind at each site was measured with a set of anemometers equally spaced in a crosswind circular array. Turbulence intensities range from less than 0.10 to greater than 0.25. Time series of wind speed at each site are characterized in both the Eulerian coordinate system and the rotating system of the turbine rotor. A straightforward rotational sampling of wind measurements is used with each vertical plane array (VPA). The differences in turbulence characteristics are discussed in relation to the complexity of the site terrain. The potential impact on a rotor is discussed briefly. The primary turbulence properties of importance in determining rotor blade forcing, energy, and size of turbulence eddies carrying most of the energy are found to vary substantially. DOE

**N88-19004#** Science and Technology Agency, Tokyo (Japan).
**8TH WIND ENERGY SYMPOSIUM**
Nov. 1986 182 p In JAPANESE
(DE88-770028; JSF-701) Avail: NTIS (US Sales Only) HC A09/MF A01

The proceedings from the 8th Wind Energy Symposium are presented. DOE

**N88-19005#** Japan Solar Energy Society, Tokyo.
**PROCEEDINGS OF THE 12TH SYMPOSIUM OF JAPAN SOLAR ENERGY SOCIETY**
Dec. 1986 194 p In JAPANESE
(DE88-770029; JSES-602) Avail: NTIS (US Sales Only) HC A09/MF A01

The proceedings from the 12th Symposium of the Japan Solar Energy Society are presented. DOE

**N88-19006#** Stuttgart Univ. (West Germany). Fakultaet fuer Elektrotechnik.
**INVESTIGATION OF THE SUBSEQUENT TREATMENT AND THE STABILITY OF CuxS-CdS THIN-FILM SOLAR CELLS Ph.D. Thesis [CUX S-CDS DUENNSCHICHT-SOLARZELLEN - UNTERSUCHUNGEN UEBER DIE NACHBEHANDLUNG UND DIE STABILITAET]**
Fritz Pfisterer 1987 203 p In GERMAN
(ETN-88-91488) Avail: NTIS HC A10/MF A01

The physical mechanisms of efficiency-improving treatment of the CuxS film in CuxS-CdS thin-film solar cells were investigated. The theoretical models describing the CuxS-CdS solar cell are presented. The measurements of the time behavior during Cu-vaporization and annealing in several atmospheres confirm the theoretical model for the subsequent treatment. The qualitative and quantitative analysis of the H2 glow process also agrees with this model. Copper interdiffusion is shown to reduce the copper content in the CuxS film, but it does not lead to degradation of the cells. It is shown that the developed technology acts against other degradation mechanisms, and that accelerated tests at high

temperature reveal degradation mechanisms. The results of the investigations complete the theoretical model and can be used to optimize the technology. ESA

**N88-19007#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**APPLICATION OF THE ESTIMATION METHOD TO PARAMETER PERFORMANCE DATE OF SOLAR WATER HEATING SYSTEMS [APLICACAO DO METODO DE ESTIMATIVA DE PARAME TROS A DADOS DE DESEMPENHO DE SISTEMAS DE AQUECIMENTO SOLAR]**
Walter Gill and Ana Osilia Paixao Leite Jul. 1987 23 p In PORTUGUESE; ENGLISH summary
(INPE-4268-PRE/1141) Avail: NTIS HC A03/MF A01

It is well known that the performance of solar water heater systems depends totally upon ambient factors, which necessitates the use of mathematical models for the correct interpretation of experimental data. Here, we apply a statistical method to data obtained from four solar water heater systems to calculate their characteristic parameters. It was found that for a good estimate of these parameters it is necessary to have at least a 5-day observation period and further, at least 15 such periods. Author

**N88-19008#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**PbSnTe PHOTOVOLTAIC DETECTORS FOR OPERATION IN THE 2-14 MICRON BAND [DETECTORES FOTOVOLTAICOS DE PBSNTE PARA OPERACAO NA FAIXA DOS 2 AOS 14 MICRON]**
C. Boschetti, C. Ying An, E. Abramof, I. N. Bandeira, M. DiasdaSilva, P. H. Oliveira Rappl, S. P. daCunha, and S. O. Ferreira Jul. 1987 23 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-4252-PRE/1125) Avail: NTIS HC A03/MF A01

The fabrication process and characterization of photovoltaic detectors for operation in the 2 to 14 micron infrared spectral range are described. The sensitive element is a p-n junction made with Pb(1-x)Sn(x)Te semiconductor alloy, whose spectral response peak varies with the composition, x, of the single crystal. The PbTe detector (x=0) has a maximum detectivity in 5.5 microns, processing a useful wavelength range from 2 to 5.8 microns. In this region, the absorption peaks of several atmospheric pollutants (HC, SO2, CO2, CO, NO), as well as the wavelength of the maximum spectral radiant emittance of aircraft turbines, are found. Detectors made of Pb0.80 Sn0.20 Te have a detectivity peak around 10 microns and, by changing the tin amount, it is possible to tune them at any wavelength between 5.5 and 14 microns. In this spectral region, the emittance of bodies near room temperature is found, which makes the detectors useful for radiometric measurement of small changes of temperature around room temperature, as well as for night reconnaissance. Author

**N88-19009#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**POLYMER REFLECTORS RESEARCH DURING FY86**
P. Schissel and H. H. Neidlinger Sep. 1987 134 p
(Contract DE-AC02-83CH-10093)
(DE88-001101; SERI/PR-255-3057) Avail: NTIS HC A07/MF A01

The long-term objectives of the Silvered Polymer Reflectors subtask within the SERI Solar Thermal Research Program are to develop silvered polymers that have a high specular reflectance and to develop modifications of polymers that will protect the silver and maintain the reflectance in outdoor environments for many years. Major progress has been made toward the specific long-term targets of a specularity resulting in 90 percent of the solar flux being contained within a cone angle of 4 to 10 mrad, and a useful life of at least 5 years. We have shown that silvered polymers can have an initial specular reflectance well over 90 percent into an acceptance angle of 1 to 2 mrad, significantly better than our long-range goals. It was further shown that these results could be obtained when the silvered polymer was mounted with an adhesive onto a smooth, flat substrate or stretched as a membrane without a firm support as in the membrane mirror configuration. Thus, the initial optics exceeds the goals, and the focus of the work is now directed to the durability of silvered polymers. Durability studies using industrial silvered polymers are conducted in accelerated weathering devices and outdoors. Outdoor tests in Colorado show that silvered polymers can maintain reflectances in excess of our long-range goals (greater than 90 percent, 4 mrad) for at least 48 weeks (18 percent of our durability goal) and the tests are continuing. Materials placed into test earlier, before we attained the full optical performance, are also providing encouraging results. Samples outdoors in Golden, Colo., for 2 1/2 years maintain reflectances near 90 percent at 12 mrad while other samples here avoided silver corrosion as determined by visual inspection for nearly 3 years. DOE

**N88-19010#** Massachusetts Inst. of Tech., Cambridge.
**PHOTOCHEMICAL ENERGY STORAGE: STUDIES OF INORGANIC PHOTOASSISTANCE AGENTS Progress Report, 1 Apr. 1985 - 30 Oct. 1987**
M. S. Wrighton 1987 37 p
(Contract DE-AC02-76ER-04178)
(DE88-002596; DOE/ER-04178/11) Avail: NTIS HC A03/MF A01

This progress report outlines research activities supported by DOE during the period April 1, 1985 to March 31, 1988. The sections of the report give a brief outline of the major features of the work. Areas of work included are: photochemistry of semiconductor photoelectrodes; quinone-viologen redox polymers; high surface area biocatalysts; intramolecular electron transfer in a porphyrin-viologen molecule; and hydrophobic surface modifiers. DOE

**N88-19011#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**PROCEEDINGS OF THE 1987 HIGH-EFFICIENCY PHOTOVOLTAIC SUBCONTRACTORS' REVIEW MEETING**
1987 80 p Meeting held in Golden, Colo., 19 May 1987
(Contract DE-AC02-83CH-10093)
(DE88-003354; SERI/CP-211-3152; CONF-8705244) Avail: NTIS HC A05/MF A01

This volume contains papers dealing with areas of interest in solar cell technology. Fourteen papers are distributed in three sections: (1) solar cell development; (2) gallium arsenide crystal growth; and (3) fundamentals of crystal growth. The papers are indexed individually. DOE

**N88-19012#** Georgia Inst. of Tech., Atlanta.
**POSITRON ANNIHILATION SPECTROSCOPY OF AlGaAs/GaAs INTERFACES IN MOCVD-GROWN GaAs HETEROJUNCTION SOLAR CELLS**
A. B. DeWald, R. L. Frost, S. A. Ringel, J. P. Schaffer, A. Rohatgi, B. Nielsen, and K. G. Lynn 1987 21 p Presented at the 34th National Vacuum Symposium and Topical Conference, Anaheim, Calif., 2 Nov. 1987 Prepared in cooperation with Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(DE88-003903; BNL-40532; CONF-871125-17) Avail: NTIS HC A03/MF A01

The defect density profile of high efficiency epitaxial MOCVD-grown GaAs heterojunction solar cell structures has been characterized using a variable-energy positron beam. By control of the implantation depth of positrons, spatial defect changes, film thickness variations, and possibly interfacial space charge and disorder may be resolved from annihilation characteristics. Correlations have been made relating positron annihilation spectroscopy (PAS) measurements to SPV data, band bending, and known MOCVD growth parameter variations. DOE

**N88-19013*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**TEST RESULTS OF A 40-kW STIRLING ENGINE AND COMPARISON WITH THE NASA LEWIS COMPUTER CODE PREDICTIONS Final Report**

David J. Allen (Sverdrup Technology, Inc., Cleveland, Ohio.) and James E. Cairelli Mar. 1988 14 p Presented at the 20th Intersociety Energy Conversion Engineering Conference, Miami Beach, Fla., 18-23 Aug. 1985; sponsored by SAE, ANS, ASME, IEEE, AIAA, ACS and AIChE Previously announced in IAA as A86-24889
(Contract DE-AI01-85CE-50112)
(NASA-TM-87050; DOE/NASA/50112-74; E-2593; NAS 1.15:87050) Avail: NTIS HC A03/MF A01 CSCL 10B

A Stirling engine was tested without auxiliaries at Nasa-Lewis. Three different regenerator configurations were tested with hydrogen. The test objectives were: (1) to obtain steady-state and dynamic engine data, including indicated power, for validation of an existing computer model for this engine; and (2) to evaluate structurally the use of silicon carbide regenerators. This paper presents comparisons of the measured brake performance, indicated mean effective pressure, and cyclic pressure variations from those predicted by the code. The silicon carbide foam generators appear to be structurally suitable, but the foam matrix showed severely reduced performance. Author

**N88-19014*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**TESTING OF A ONE-BLADED 30-METER-DIAMETER ROTOR ON THE DOE/NASA MOD-O WIND TURBINE Final Report**
C. B. F. Ensworth, III, R. D. Corrigan, and B. M. Berkowitz (Sverdrup Technology, Inc., Cleveland, Ohio.) Mar. 1988 13 p
(Contract DE-AI01-76ET-10320)
(NASA-TM-100274; E-3916; DOE/NASA/20320-74; NAS 1.15:100274) Avail: NTIS HC A03/MF A01 CSCL 10B

Tests were conducted on the DOE/NASA Mod-O 200-kW horizontal-axis wind turbine in a one-bladed rotor configuration. The objectives of the test were to evaluate the performance, loads, and dynamic characteristics of a one-bladed rotor, and then to compare these parameters with those of an aerodynamically similar two-bladed rotor configuration. Test operations showed that this intermediate-size (15.2-m radius) one-bladed rotor configuration can be operated successfully. Test results show that the one-bladed rotor had cyclic blade loads comparable to those of a two-bladed rotor. A moderate power penalty equivalent to a reduction in windspeed of 1 m/sec occurred with the one-bladed rotor when operated at a rotor speed 50 percent higher than that of the two-bladed rotor. Author

**N88-19015#** Illinois Dept. of Energy and Natural Resources, Springfield.
**ALTERNATIVE ENERGY IN THE MIDWEST: RESEARCH AND APPLICATIONS. CONFERENCE PROCEEDINGS, ROSEMONT, ILLINOIS, MARCH 19-20, 1987**
R. Swager Dec. 1987 515 p Conference held in Rosemont, Ill., 19-20 Mar. 1987
(PB88-142278; IL/ENR/AE-87/06) Avail: NTIS HC A22/MF A01 CSCL 10A

Session topics included: wind energy, waste-to-energy, photovoltaics, alternative transportation fuels, energy storage, biomass production and use, solar energy, project development and financing, and government policy and planning. GRA

# 45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

**N88-19016#** Army Construction Engineering Research Lab., Champaign, Ill.
**ENVIRONMENTAL GRADIENT ANALYSIS, ORDINATION, AND CLASSIFICATION IN ENVIRONMENTAL IMPACT ASSESSMENTS Final Report**
Anthony J. Krzysik Sep. 1987 124 p
(AD-A187294; CERL-TR-N-87/19) Avail: NTIS HC A06/MF A01 CSCL 06F

This report develops the theoretical foundation for analytical description and quantification of habitat structure. The analytical description of environmental gradients is shown to be an eigenanalysis problem, mathematically equivalent to the largest eigenvector (or first principal component) of a principal components analysis. The analytical representation of an environmental gradient, itself a single variable, is empirically demonstrated to have similar ecological information as the combination of all the original 58 habitat variables describing five Mojave Desert study sites. Two vastly different data bases were analyzed to explore the effects of sample sizes and variable selection on the ordination of study sites in both principal components and canonical variate space. Merits and shortcomings of principal components analysis, canonical analysis of discriminance, and cluster analysis for the ordination and classification of samples are reviewed in detail. Canonical analysis of discriminance is a very effective mechanism for classifying samples into a priori established groups, or for identifying variables that contribute significantly to group discrimination. GRA

**N88-19017#** IIT Research Inst., Chicago, Ill.
**ELF (EXTREMELY LOW FREQUENCY) COMMUNICATIONS SYSTEM ECOLOGICAL MONITORING PROGRAM: ELECTROMAGNETIC FIELD MEASUREMENTS AND ENGINEERING SUPPORT, 1986 Technical Report, 1982 - 1986**
D. P. Haradem, J. R. Gauger, and J. E. Zapotosky Sep. 1987 264 p
(Contract N00039-84-C-0070)
(AD-A188057; IITRI-E06549-37) Avail: NTIS HC A12/MF A01 CSCL 06F

A long-term program for studying possible effects from the operation of the Navy's ELF Communications System is being conducted on biota and ecosystems components in northwestern Wisconsin and the Upper Peninsula of Michigan. Sixteen general types of organisms from three major ecosystems in the ELF system area are being examined. Formulation of an ELF Ecological Monitoring Program was completed in early 1982 by the Department of the Navy, and studies were initiated in late summer of the same year. Beginning in 1983 and continuing during 1984, major activities of the program consisted of characterization of critical aspects of each study, collection of each study, collection of data to validate assumptions made in proposals, and selection of study sites. 1985 and 1986 activities centered on the operation of full scale studies. This report documents electromagnetic (EM) field measurement at investigator selected study sites from 1982 through 1986, and presents the status of the sites in light of the EM exposure criteria. Other engineering support activities are also described. GRA

**N88-19018#** Harvard School of Public Health, Boston, Mass.
**PROCEEDINGS OF THE 19TH DOE/NRC AIRBORNE WASTE MANAGEMENT AND AIR CLEANING CONFERENCE**
Melvin W. First, ed. May 1987 643 p Conference held in Seattle, Wash., 18-21 Aug. 1986 Sponsored in part by Nuclear Regulatory Commission, Washington, D.C.
(Grant NRC-04-86-304)
(NUREG/CP-0086-Vol-1; CONF-860820) Avail: NTIS HC A99/MF A01

This is Volume 1 of a two-volume collection of papers and associated discussions of the 19th DOE/NRC Nuclear Air Cleaning Conference. Sessions were devoted to: (1) fire, explosion, and accident analysis, (2) adsorption and iodine retention, (3) filters and filter testing, (4) standards and regulation, (5) treatment of radon, krypton, tritium, and carbon-14, (6) ventilation and air cleaning in reactor operations, (7) dissolver off-gas cleaning, (8) adsorber fires, (9) nuclear grade carbon testing, (10) sampling and monitoring, and (11) field test experience. Author

**N88-19019#** Harvard School of Public Health, Boston, Mass.
**PROCEEDINGS OF THE 19TH DOE/NRC AIRBORNE WASTE MANAGEMENT AND AIR CLEANING CONFERENCE**
Melvin W. First, ed. Apr. 1987 628 p Conference held in Seattle, Washington, 18-21 Aug. 1986 Sponsored in part by

Nuclear Regulatory Commission, Washington, D.C.
(Grant NRC-04-86-304)
(NUREG/CP-0086-Vol-2; CONF-860820) Avail: NTIS HC A99/MF A01

This is Volume 2 of a two-volume collection of reports and associated discussions taking place at the 19th DOE/NRC Nuclear Air Cleaning Conference. Sessions were devoted to the following topics: fire, explosion and accident analysis; adsorption and iodine retention; filters and filter testing; standards and regulation; the treatment of radon, krypton, tritium, and carbon-14; ventilation and air cleaning in reactor operations; dissolver off-gas cleaning; adsorber fires; nuclear grade carbon testing; sampling and monitoring; and field test experience. Author

**N88-19020#** Microelectronics Center of North Carolina, Research Triangle Park.
**COMPUTER ARCHITECTURE FOR RESEARCH IN METEOROLOGY AND ATMOSPHERIC CHEMISTRY Final Report**
J. McHugh, J. Pierce, D. Rich, J. Dunham, and D. McLin Dec. 1987 138 p Sponsored by EPA, Research Triangle Park, N.C. Prepared in cooperation with Research Triangle Inst., Research Triangle Park, N.C.
(PB88-145313; EPA-600/3-87/049) Avail: NTIS HC A07/MF A01 CSCL 13B

The feasibility of constructing a peripheral hardware module that could be attached to a mini or midsized computer to accelerate the execution of large air pollution models, such as the EPA's Regional Oxidant Model (ROM) is examined. Crucial information necessary to design such an accelerator is acquired by running the ROM computer code under instrumentation which shows how the computational load is distributed within the model and the data transfer rates between each step of the model execution. These data reveal that a model such as the ROM is not amenable to acceleration using a vector-type architecture because the computational burden is too inhomogeneous in space and time. Simulations show that an accelerator based on the tile machine architecture would be capable of executing the ROM up to 100 times faster than the host machine working alone. GRA

**N88-19021#** International Council of Scientific Unions, Paris (France).
**INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAM: A STUDY OF GLOBAL CHANGE Final Report**
4 Aug. 1986 27 p
(PB88-142393) Avail: NTIS HC A03/MF A01 CSCL 13B

A better understanding of the Earth and its immediate environment is essential if the ability to detect and to respond to warnings of significant global change are to be improved. Although the world community of scientists has in the last 30 years successfully completed a wide range of international programs. The program will be tightly focused, with emphasis on interactive processes that are not addressed by other existing programs. Topics suggested for early emphasis in the IGBP include: studies of biogeochemical cycles; studies of the ocean euphotic zone; studies of soil dynamics and soil chemistry; and studies of variable solar inputs to the Earth. Emphasis is also put on the need for development of an adequate global data and information system, that must be an integral part of the program. GRA

# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

**N88-19022#** Saint Louis Univ., Mo.
**Lg WAVE EXCITATION AND PROPAGATION IN THE PRESENCE OF ONE-, TWO-, AND THREE-DIMENSIONAL HETEROGENEITIES Final Report, 1 Apr. 1985 - 31 Mar. 1987**
R. B. Herrmann 15 Jul. 1987 82 p
(Contract F19628-85-K-0029; ARPA Order 5299)
(AD-A187364; AFGL-TR-87-0229) Avail: NTIS HC A05/MF A01 CSCL 08K

The scattering of Lg waves by point heterogeneities in a crustal waveguide is considered. Computer simulations lead to inferences of the behavior of the scattering mechanism which helps understand observed facts about the shear wave coda, especially the relationship between the lag time at which measurements are made and the inferred coda Q. A second study reports on problems on some routine processing techniques used for long period surface wave analysis. The influence of spectral shape on inferred spectral amplitudes is discussed. GRA

**N88-19023#** Science Applications International Corp., San Diego, Calif.
**REGIONAL WAVE ATTENUATION AND SEISMIC MOMENT FROM THE INVERSION OF NORESS SPECTRA Semiannual Report No. 2, 1 Sep. 1986 - 28 Feb. 1987**
Thomas J. Sereno, Jr., Steven R. Bratt, and Thomas C. Bache 31 Jul. 1987 124 p
(Contract F19628-86-C-0051)
(AD-A187399; SAIC-87/1736; AFGL-TR-87-0237) Avail: NTIS HC A06/MF A01 CSCL 08K

Frequency-dependent regional wave attenuation along continental paths to the NORESS array in Norway is investigated. Regional Lg and Pn spectra from 190 events, at distances between 200 and 1300 km, have been inverted for seismic moment and apparent attenuation. Our method uses both the spectral and spatial decay of observed signal amplitudes to separate source and path contributions. Based on adequate signal/noise, the Lg spectra were inverted between 1 and 7 Hz and the Pn spectra between 1 and 15 Hz. The data are parameterized by an omega - sq source spectrum with cube-root corner frequency scaling and an assumed geometric spreading function. Most events considered have local magnitudes less than 3.0, so the corner frequencies are near or beyond the upper limit of the bandwidth inverted. The spectra are inverted for source moment, a constant relating corner frequency and moment, and two parameters describing a power-law frequency dependence of Q. For fixed source and spreading assumptions, the inversion defines clear trade-offs among model parameters. To resolve these trade-offs, constraints are added to the separately derived source parameters Lg and Pn that they be consistent. The inversion results for seismic moment as a function of local magnitude are generally consistent with near-field studies. GRA

**N88-19024#** Colorado Univ., Boulder.
**A SPECTRAL METHOD FOR COMPUTING COMPLETE SYNTHETIC SEISMOGRAMS Final Report, 25 Oct. 1984 - 31 Dec. 1986**
Danny J. Harvey Mar. 1987 36 p
(Contract F19628-85-K-0016)
(AD-A187663; AFGL-TR-87-0238) Avail: NTIS HC A03/MF A01 CSCL 08K

Much attention has been paid to the problem of the efficient computation of complete solution synthetic seismograms for flat, plane layered, laterally homogeneous elastic media and for high frequency bandwidths in the field of solid-earth geophysics. The only available methods for computing complete synthetic seismograms are computationally expensive and often suffer from numerical instabilities which limit their ranges of applicability. This report presents a new method based on a spectral representation of the solution of the elastic wave equation. Reformulating eigenvalue and eigenfunction computations avoids the numerical instabilities. A mode searching algorithm is developed which makes it possible to find large numbers of Rayleigh and Love dispersion curves efficiently and reliably. The locked mode approximation allows nearly complete synthetic seismograms to be computed using only the discrete part of the spectrum and using only normal modes with real eigen wave numbers. This is achieved by adding a high velocity cap layer to the bottom of the elastic model and by using phase velocity filtering to attenuate the spurious scattering caused by the cap layer. Comparisons of the results of the locked

mode approximation with exact results obtained from other synthesis methods are presented and the limitations of the method are demonstrated and discussed. Examples of synthetic seismograms using the locked mode approximation are given along with a comparison of observed and synthetic seismograms. GRA

**N88-19025#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
**COMPUTER APPLICATIONS IN GEOTECHNICAL ENGINEERING (CAGE) AND GEOTECHNICAL ASPECTS OF THE COMPUTER-AIDED STRUCTURAL ENGINEERING (G-CASE) PROJECTS. USER'S GUIDE. UTEXAS2 SLOPE-STABILITY PACKAGE. VOLUME 1: USER'S MANUAL Final Report**
Earl V. Edris, Jr. Aug. 1987 220 p
(AD-A187674; WES/IR/GL-87-1-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 08J

This report is the user's guide volume of the UTEXAS2 (University of Texas Analysis of Slopes - version 2) slope-stability package. This package describes a slope-stability program which can calculate the factor of safety by Spencer's method, simplified Bishop's procedure, force equilibrium procedure with Corps of Engineers Modified Swedish side-force assumption of parallel side forces at a user-specified inclination and force equilibrium procedure with Lowe and Karafiath's side force assumptions. The program will calculate the safety factor for either a prescribed shear surface or for a search of the critical shear surface. Both circular and noncircular shear surfaces can be evaluated. There are five options for the type of shear strength data and six options for specifying pore pressures. All analysis procedures and major features can be run in a single data file which is free-field format and utilizes command words. Graphics capability for displaying the input data and the final shear surface is available. Special capabilities include pseudo-static seismic analysis, slope reinforcement, curved (multi-linear) shear strength envelope, anisotropic shear strength, and the ability to have multiple piezometric lines. GRA

**N88-19026#** Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
**USU (UTAH STATE UNIVERSITY) CENTER OF EXCELLENCE IN THEORY AND ANALYSIS OF THE GEO-PLASMA ENVIRONMENT Annual Report, 1 Oct. 1986 - 30 Sep. 1987**
Robert W. Schunk 30 Oct. 1987 46 p
(Contract F49620-86-C-0109)
(AD-A187687; AFOSR-87-1900TR) Avail: NTIS HC A03/MF A01 CSCL 04A

The overall goal of the research is to obtain a better understanding of the basic chemical and physical processes operating in the geoplasma environment, including the ionosphere, thermosphere, and magnetosphere. Some of the specific tasks include the following: (1) Studies of ionospheric structure and irregularities; (2) Study the feasibility of developing better operational ionospheric models for the Air Force; (3) Conduct model/data comparisons in order to validate the ionospheric models; (4) Study plasma convection characteristics in the high-latitude ionosphere; (5) Study magnetosphere-ionosphere coupling problems; (6) Construct a thermospheric general circulation model; (7) Develop a 3D, time-dependent model of the outer plasmasphere; (8) Develop a 3D, time-dependent MHD model of the earth's magnetosphere; (9) Conduct satellite drag studies; and (10) Study certain spacecraft-environment interaction problems, including those related to high-voltage power sources, spacecraft outgassing, and spacecraft charging at LEO altitudes. GRA

**N88-19027#** Southampton Univ. (England). Dept. of Chemistry.
**GAS-PHASE PHOTOELECTRON SPECTROSCOPY OF METALS AND METAL OXIDES OF IMPORTANCE IN THE UPPER ATMOSPHERE Final Report, 1 Sep. 1983 - 31 Aug. 1987**
J. M. Dyke 1 Oct. 1987 11 p
(Grant AF AFOSR-0283-83)
(AD-A187771; AFOSR-87-1634TR) Avail: NTIS HC A03/MF A01 CSCL 04A

Photoelectron spectroscopy is used to study in the gas phase the electronic structure of metals and metal oxides which are of importance in the upper atmosphere. Ionization energies and cross-sections at discrete wavelengths are obtained. Exothermicities of charge exchange reactions of metal oxides and dioxides of importance to atmospheric modelling calculations will be determined. GRA

**N88-19028#** Naval Postgraduate School, Monterey, Calif.
**NORTHERN WINTER CIRCULATIONS FOR THE PERIOD 1974-1983 Final Technical Report, Aug. 1986 - Aug. 1987**
James S. Boyle and C.-P. Chang 30 Nov. 1987 89 p
(AD-A187779; NPS-63-87-005) Avail: NTIS HC A05/MF A01 CSCL 04A

This is the final report of the study on the winter atmospheric circulation for the decade 1974 to 1983. Part 1 is an observational study of the time mean flow and transients for the northern wintertime for the period 1974/5 to 1982/3. Part 2 is an observational study of the divergent flow for the tropics and midlatitudes in the northern wintertime for the period 1974/5 to 1982/3. GRA

**N88-19029#** Chemical Research and Development Center, Aberdeen Proving Ground, Md.
**OPTICAL CHARACTERIZATION OF TROPOSPHERIC AEROSOLS Technical Report, Jan. 1981 - Dec. 1982**
Hugh R. Carlon Sep. 1987 25 p
(AD-A187839; CRDEC-TR-87070) Avail: NTIS HC A03/MF A01 CSCL 07C

Complex calculations of optical scattering using high-speed electronic computers have become so commonplace that the technology has evolved into several specialty fields, e.g., extinction spectroscopy, angular scattering measurements, and nephelometry. As a consequence, the overall technology and our ability to remotely characterize or quantitatively analyze atmospheric aerosols might be further advanced than realized by workers in the individual disciplines who do not have the time to keep up with advances in other disciplines. This report examines techniques of transmission (extinction) and turbidity spectroscopy, polarization and angular scattering measurements and related developments, and concludes that computer programs can be written to optimize desired parameters in interdisciplinary investigations. GRA

**N88-19030#** Naval Postgraduate School, Monterey, Calif.
**PROJECT SKYLITE: A DESIGN EXPLORATION M.S. Thesis**
William J. Welch and Mark F. Landers Sep. 1987 144 p
(AD-A187906) Avail: NTIS HC A07/MF A01 CSCL 04A

Project SKYLITE is an experiment which will assess compensating techniques designed to reduce laser wave front distortion caused by the atmosphere. The satellite will measure and downlink the propagated beam irradiance of the Mid-IR Advance Chemical Laser (MIRACL), based at the White Sands Missile Range, N.M. The spacecraft will be designed to measure laser beam quality and power of both high and low power laser experiments. The irradiance and power values will vary as different compensating methods are employed. The spacecraft, which is gravity gradient stabilized, provides an array of infrared sensors in the 3.6 to 4.2 micron window to measure laser irradiance. Use of several retroreflectors appended to the satellite will provide for precision pointing and turbulence correction measurements using a ground based Alexandrite laser. Due to the high energy involved during the lasing experiment, highly reflective radiation shielding of both sensitive equipment and the solar array will be required to allow for survivability throughout its 3-year life without thermal or structural degradation. To minimize cost, Project SKYLITE will use the space shuttle standard canister for small self-contained payloads known as the Extended Get Away Special (GAS) can. The satellite has been designed to use the Orion bus currently being designed by NPS. Use of off-the-shelf technology for both economy and rapid procurement processes has been a prime consideration throughout the design to meet the initial operation capability deadline of first quarter FY-89. The satellite expense, estimated with the Air Force Unmanned Spacecraft Cost Model,

is approximately 3.9 M for recurring costs and 14.8 M for nonrecurring costs. GRA

**N88-19031#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
**UPPER-THERMOSPHERIC OBSERVATIONS AND NEUTRAL-GAS DYNAMICS AT HIGH LATITUDES DURING SOLAR MAXIMUM Ph.D. Thesis**
Christopher R. Tschan 1987 316 p
(AD-A188058; AFIT/CI/NR-87-135D) Avail: NTIS HC A14/MF A01 CSCL 04A

The objective of this theses was to understand the neutral gas dynamics in the high latitude regions of the Earth's upper thermosphere and the the morphology of the neutral winds and the forces which drive or modify them. A unique 70 orbit December solstice dataset was established, which included satellite neutral winds and other supporting data from Dynamics Explorer 2 (DE-2), with coverage of both polar caps during the same orbit. Analysis of this data led to the characterization of four basic high latitude neutral-wind signature categories for each hemisphere under various interplanetary-magnetic-field (IMF) configurations. Furthermore, sunward neutral winds on the duskside of the polar cap, resulting from the mapping of the twin cell ion convection onto the neutral gas through ion-neutral collisions, were well established in all cases. However, the dawnside sunward neutral winds were not as well established. The existence of a small region of dawnside neutral winds was noted in the winter Northern Hemisphere, but was usually absent in the summer Southern Hemisphere. Analysis of the individual neutral gas forces for solar-maximum December-solstice from the NCAR thermospheric general circulation model (TGCM), led to the realization that the polar cap pressure gradient force in the winter Northern Hemisphere had a different orientation than in the summer Southern Hemisphere. GRA

**N88-19032#** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
**STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE US. PARAMETERS FOR SPECIFYING INTENSITY-RELATED EARTHQUAKE GROUND MOTIONS**
E. L. Krinitzsky and Frank K. Chang Sep. 1987 129 p
(AD-A188230; WES/MP/S-73-1-25; AEWES-25) Avail: NTIS HC A07/MF A01 CSCL 08K

A set of 12 charts is presented relating Modified Mercalli intensity units to peak horizontal acceleration, velocity and duration for near field and far field locations, hard and soft sites, and sizes of earthquakes. Also shown is the mean, mean plus one standard deviation, mean plus two standard deviations, and the highest observed values. Ratios of vertical to horizontal motions and predominant periods are provided. These charts are for use with known fault sources and for floating earthquakes in zones where there are no identifiable causative faults. The procedure provides parameters for shaping time histories to be used for dynamic analyses. GRA

**N88-19033#** Lawrence Livermore National Lab., Calif.
**INITIAL RESULTS WITH THE LLNL 2-D CHEMICAL-RADIATIVE-TRANSPORT MODEL OF THE TROPOSPHERE AND STRATOSPHERE**
D. J. Wuebbles, P. S. Connell, K. E. Grant, R. Tarp, and K. E. Taylor Sep. 1987 14 p
(Contract W-7405-eng-48)
(DE88-004355; UCID-21178) Avail: NTIS HC A03/MF A01

Significant progress has been made in the development of a zonally averaged (two-dimensional) chemical-radiative-transport model of the troposphere and stratosphere. Although further model development and refinement is being planned, the 2-D model is currently ready to be applied to appropriately designed research studies of stratospheric chemical processes and interactions. Several such studies are now underway. This paper provides a description of the existing 2-D model and discusses some of the pertinent results for evaluating the capabilities of the model. Special attempts at improving the timing of the model are also discussed. DOE

**N88-19034#** Lawrence Livermore National Lab., Calif.
**ENERGETIC PARTICLE DRIFT MOTIONS IN THE OUTER DAYSIDE MAGNETOSPHERE Ph.D. Thesis**
R. M. Buck Dec. 1987 211 p
(Contract W-7405-eng-48)
(DE88-005097; UCRL-53806) Avail: NTIS HC A10/MF A01

Models of the geomagnetic field predict that within a distance of approximately one earth radius inside the dayside magnetopause, magnetic fields produced by the Chapman-Ferraro magnetopause currents create high-latitude minimum-B pockets in the geomagnetic field. Drift-shell branching caused by the minimum-B pockets is analyzed and interpreted in terms of an adiabatic shell branching and rejoining process. We examine the shell-branching process for a static field in detail, using the Choe-Beard 1974 magnetospheric magnetic field model. We find that shell branching and rejoining conserves the particle mirror field B(sub M), the fieldline integral invariant I, and the directional electron flux j. We determine the spatial extent of the stable trapping regions for the Choe-Beard model. We develop an adiabatic branching map methodology which completely identifies and describes the location of shell-branching points and the adiabatic trajectories of particles on branched shells, for any model field. We employ the map to develop synthetic pitch angle distributions near the dayside magnetopause by adiabatically transforming observed midnight distributions to the dayside. DOE

**N88-19035** Colorado Univ., Boulder.
**THE INFLUENCE OF ATMOSPHERIC THERMAL TIDES ON DIURNAL VARIATIONS IN CHEMICAL CONSTITUENTS IN THE MESOSPHERE Ph.D. Thesis**
Gudmundur Gisli Bjarnason 1987 157 p
Avail: Univ. Microfilms Order No. DA8723444

Numerous observations have shown large diurnal changes of chemical species such as ozone and OH in the upper earth atmosphere. Many of these changes cannot be explained by photochemistry alone, so other physical processes must play an important role. To investigate the possible interaction of dynamics and photochemistry, a one-dimensional photochemical model was developed which includes a time varying vertical diffusion coefficient K sub zz. Observations of the diurnal changes in the zonal wind from Poker Flat, Alaska are used to determine the diurnal variability of the vertical diffusion used in the photochemical model. Comparisons of results from photochemical model calculations withthose in which K sub zz is changing in time show large differences in the diurnal variation of ozone and other species between 70 and 90 km. By including this dynamical effect, much better agreement with the Solar Mesosphere Explorer satellite ozone data is obtained. The time behavior of calculated K sub zz is also consistent with turbulence data from Poker Flat. The influence of including the dynamical effect on OH densities is also large, especially between 80 and 90 km, suggesting that this effect may affect the airglow emission from the Meinel bands. An atmospheric thermal tidal model was developed for the purpose of calculating the effects of tidally induced temperature changes on the results. Although of secondary importance, these effects are considerable, even at high latitudes and can not be neglected. Dissert. Abstr.

**N88-19036** Arizona Univ., Tucson.
**PHOTOACOUSTIC MEASUREMENTS OF ATMOSPHERIC AEROSOL ABSORPTION COEFFICIENTS AT ULTRAVIOLET, VISIBLE AND INFRARED WAVELENGTHS Ph.D. Thesis**
Debby Colleen Ramsey-Bell 1987 171 p
Avail: Univ. Microfilms Order No. DA8716358

A photoacoustic spectrometer was developed and built for measuring absorption of light by collected particles. Comparisons were made between photoacoustic absorption spectra and spectra calculated with Mie theory. Aerosol particles were collected in different environments in southern Arizona under background conditions in the mid-troposphere, and in a moderately polluted

city. Results for the two locations, and two size ranges, are compared and contrasted. Normalized photoacoustic absorption spectra for urban aerosols are uniform with wavelength; background aerosol spectral have a relative increase in absorption at near UV wavelengths compared to near IR wavelengths. Urban aerosol absorption can be attributed to carbon particles larger than approximately 0.1 micron. Absorption by hematite particles is more strongly wavelength dependent than absorption by carbon particles of the same size. This wavelength dependence is still not great enough to be attributed to hematite alone, although submicron hematite particles may be the dominant absorber in coarse background aerosol. Dissert. Abstr.

**N88-19037*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**CRUSTAL DYNAMICS PROJECT: CATALOGUE OF SITE INFORMATION**
Carey E. Noll, ed. Mar. 1988 539 p
(NASA-RP-1198; Rept-88B9999; NAS 1.61:1198) Avail: NTIS HC A23/MF A01 CSCL 08G

This document represents a catalog of site information for the Crustal Dynamics Project. It contains information on and descriptions of those sites used by the Project as observing stations for making the precise geodetic measurements necessary for studies of the Earth's crustal movements and deformation. Author

**N88-19038#** Texas Univ., Austin. Center for Transportation Research.
**APPLICATIONS AND LIMITATIONS OF THE SPECTRAL-ANALYSIS-OF-SURFACE-WAVES METHOD Final Research Report**
J. C. Sheu, K. H. Stokoe, J. M. Roesset, and W. R. Hudson Nov. 1986 292 p Sponsored by Federal Highway Administration, Austin, Tex. and Texas State Dept. of Highways and Public Transportation, Austin
(PB88-136619; CTR-3-8-85-437-3F; FHWA/TX-87/70-437-3F) Avail: NTIS HC A13/MF A01 CSCL 08K

The Spectral-Analysis-of-Surface-Waves (SASW) method is an in situ seismic method for nondestructively determining the modulus profiles of geotechnical, pavement, and structural systems. By generating and measuring surface waves in the field, a dispersion curve, a plot of surface wave velocity versus wavelength, is constructed. This dispersion curve is then inverted in the office. Inversion is an analytical process for reconstructing the shear wave velocity profile from the field dispersion curve. Layering and the Young's modulus of each layer are readily obtained from the shear wave velocity profile. To understand the impact from the existence of reflecting boundaries in the real world such as joints or edges in a pavement system, a simplified model was developed. Field experiments were then performed to verify this model. Several case studies are presented to illustrate the versatility of the SASW method, and a MASSCOMP microcomputer was introduced in an attempt to automate the SASW method. Author

**N88-19039#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**RADIATION BALANCE COMPONENTS ABOVE THE TROPICAL EVERGREEN AMAZON FORESTS (3RD CAMPAIGN OF DATA COLLECTION) [COMPONENTES DO BALANCO DE RADIACAO ACIMA DA COPA DA FLORESTA AMAZONICA (TERCEIRA CAMPANHA DE COLETA DE DADOS)]**
Yelisetty Viswanadham, Romisio Geraldo Bouh Andre (Universidade Estadual de Campinas, Brazil ), Leonardo DeanedeAbreuSa, Antonio Ocimar Manzi, and Vicente dePaulaSilvaFilho Jun. 1987 47 p In PORTUGUES; ENGLISH summary
(INPE-4195-PRE/1079) Avail: NTIS HC A03/MF A01

Daytime variation of radiation balance components of solar radiation K(incident), reflected radiation K(reflected), net radiation Q(net) and net longwave radiation L(net), from July to August 1984, over the tropical evergreen Amazon forest was investigated. The variation of Q(net) is similar to that of K(incident). During daytime hours the differences in K(incident) and Q(net) are significant due to the presence of convective clouds, and exhibit a systematic pattern. The maximum values of K(incident) and Q(net) were 1301 and 713 W/sq m, respectively. The behavior of Q(net) was explained from the radiant input K(incident) and net longwave radiation L(net). A strong dependence of the albedo on the zenith angle is evident. This dependence is subdued during cloudy days. The daily albedo of solar radiation determined over the forest canopy varied from a maximum value of 0.33 (in the afternoon) to a minimum value of 0.12 (in the middle of the day). Author

**N88-19040*#** National Aeronautics and Space Administration, Washington, D.C.
**NEW DATA ON THE FORMATION CONDITIONS AND AGE OF THE KAMENSK AND GUSEV ASTROBLEMES**
Ye. V. Movshovich and A. Ye. Milyavskiy Mar. 1988 16 p Transl. into ENGLISH from Meteoritika (USSR), issue 45, 1986 p 112-118 Original language document was announced in IAA as A87-34319 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20212; NAS 1.77:20212) Avail: NTIS HC A03/MF A01 CSCL 04A

Discussed is new information recently published on the higher contents of siderophilic in the block breccia, fragments of coesite rocks in the Glubokinskiy series within the Kamenskiy astrobleme. New geological data which have refined the concept regarding the structure and age of the Kamenskiy astrobleme are presented. Author

**N88-18759#** Joint Publications Research Service, Arlington, Va.
**OBSERVATIONS AND ANALYSES OF SUMMER WHISTLERS AT THE GREAT WALL STATION OF ANTARCTICA Abstract Only**
Changming He *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 22 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica) (Beijing, China), v. 30, no. 2, Mar. 1987 p 109-118 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

**N88-18760#** Joint Publications Research Service, Arlington, Va.
**EVOLUTION OF ACOUSTIC GRAVITY WAVE PACKET IN SPATIALLY AND TEMPORALLY VARYING WIND Abstract Only**
Fan Yi, Baixian Liang, and Jun Li *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 23 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica), (Beijing, China), v. 30, no. 7, Mar. 1987 p 119-127 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

**N88-18761#** Joint Publications Research Service, Arlington, Va.
**TEMPORAL EVOLUTION OF IONOSPHERIC ELECTRIC FIELD DRIVEN BY FIELD-ALIGNED CURRENT Abstract Only**
Youmin Guo *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 24 Transl. into ENGLISH from Diqiu Wuli Xuebao (Acta Geophysica Sinica), (Beijing, China), v. 30, no. 7, Mar. 1987 p 128-135 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

# 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N88-19041#** General Accounting Office, Washington, D. C. Resources, Community and Economic Development Div.
**AVIATION WEATHER: STATUS OF FAA'S (FEDERAL AVIATION ADMINISTRATION'S) NEW HAZARDOUS WEATHER DETECTION AND DISSEMINATION SYSTEMS**
Sep. 1987 32 p

(PB88-115910; GAO/RCED-87-206; B-222882) Avail: NTIS HC A03/MF A01 CSCL 05A

A review of the Federal Aviation Administration's efforts to develop better ground based hazardous weather detection systems and to disseminate the information to pilots in a more timely manner is summarized. Author

**N88-19042#** Naval Postgraduate School, Monterey, Calif.
**VARIATION OF THE WIND STRESS RELATED TO FRONTAL PASSAGES DURING FASINEX (FRONTAL AIR-SEA INTERACTION EXPERIMENT) 1986 M.S. Thesis**
James F. Mundy Sep. 1987 76 p
(AD-A187180) Avail: NTIS HC A05/MF A01 CSCL 04B

The variations of wind stress on the ocean surface during the passages of atmospheric cold fronts are investigated using data collected during the 1986 Frontal Air-Sea Interaction Experiment (FASINEX). Six frontal passages were observed from two ships (R/V's Oceanus and Endeavor) in the western North Atlantic during the period 14 February to 6 March 1986. Wind stresses are calculated by both the dissipation method, using velocity variances measured with hot-film anemometers, and the bulk method, using mean wind, temperature, and humidity and a drag coefficient. The ratio of dissipation to bulk stress is found to be enhanced by a factor of up to 1.4 within approximately 200 km of a frontal zone when averaged over six frontal passages. The enhancement during individual frontal passages was as high as 3.6, with the major peaks occurring from 300 km ahead of the front to 400 km behind the front. Investigation of the differences in direction between surface wind and sea swell suggests that the enhancement is produced in large part through a combination of two factors: modulation of high-frequency wind waves by underlying swell and chaotic seas resulting from radiation of swell waves generated in the cold sector through the front. GRA

**N88-19043#** Woods Hole Oceanographic Institution, Mass.
**AIR TEMPERATURE SHIELD TESTS**
Richard E. Payne Oct. 1987 28 p
(Contract N00014-84-C-0134; Grants NSF OCE-81-22061; NSF OCE-82-11108)
(AD-A187459; WHOI-87-40) Avail: NTIS HC A03/MF A01 CSCL 04B

Measurements were made with a group of sensors for 37 days at the end of a dock in Vineyard Sound. The sensors included: a thermistor in an R.M. Young aspirated air temperature radiation shield, a thermistor in an R.M. Young multiplate shield, wind speed and direction, and solar irradiance. For the last eight days we also included a WHOI built cylindrical radiation shield. For wind speeds above 2 m/s, the multiplate shield had an RMS error relative to the aspirated shield of 0.2 to 0.3 C during day-light hours. Adding a correction linear in solar irradiance decreased the error by a factor of one third to one half. The cylindrical shield appears to have performed better than this but there was insufficient data to support this conclusion statistically. GRA

**N88-19044#** Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
**GROUND CLUTTER PROCESSING FOR WIND MEASUREMENTS WITH AIRPORT SURVEILLANCE RADARS Project Report**
Mark E. Weber 4 Nov. 1987 63 p Original contains color illustrantions
(Contract F19628-85-C-0002)
(AD-A187708; ATC-143; DOT/FAA/PM-87/21) Avail: NTIS HC A04/MF A01 CSCL 17I

Modern airport surveillance radars (ASR) are coherent pulsed-Doppler radars used for detecting and tracking aircraft in terminal area air-space. These radars might serve an additional role by making radial wind measurements in the immediate vicinity of an airport to provide data on low altitude wind shear (LAWS). One factor that will affect their capability in this role is the requirement that intense low-beam ground clutter be filtered from the signals prior to estimation of the reflectivity and radial velocity of weather scatterers. This report describes and analyzes a specific signal processing algorithm for ASR weather parameter measurements. An adaptively selected Finite Impulse Response high-pass filter, is used for ground clutter suppression, followed by pulse-pair weather reflectivity and radial velocity estimation. Measurements from a Lincoln Laboratory- developed testbed ASR in Huntsville, Alabama are used to characterize the ground clutter environment under siting conditions that are representative of operational ASRs. Temporal fluctuations in ground clutter intensity are analyzed with attention to their impact on the adaptive clutter-filter selection procedure. The performance of the signal processing algorithms is then analyzed using the testbed ASR ground clutter measurements in combination with simulated or real weather signals. We conclude that ground clutter and the requisite clutter filtering will not severely distort ASR wind shear measurements when the reflectivity factor of the microbursts or gust front is approx. 20 dBz or greater. This is typically the case for microbursts occurring in moist conditions such as prevail over the Eastern United States during summer. GRA

**N88-19045#** Naval Postgraduate School, Monterey, Calif.
**CORRECTION OF THE WIND FIELD MEASURED BY THE NCAR ELECTRA DURING FASINEX (FRONTAL AIR-SEA INTERACTION EXPERIMENT) FOR INERTIAL NAVIGATION SYSTEM DRIFTS**
William J. Shaw and Gail T. Vaucher Oct. 1987 49 p
(AD-A187780; NPS-63-87-008) Avail: NTIS HC A03/MF A01 CSCL 04B

This report describes a technique for removal of inertial navigation system drifts from winds measured by the NCAR Electra during the Frontal Air-Sea Interaction Experiment (FASINEX) in 1986. Without correction, horizontal wind divergences calculated from these data may contain errors as large as 0.0001 per sec resulting from the Schuler oscillation. After correction, the divergence error is reduced by at least an order of magnitude. Correction coefficients and a subroutine to use them were provided for the five of six FASINEX flights for which correction was possible. GRA

**N88-19046#** Air Force Environmental Technical Applications Center, Scott AFB, Ill.
**MOSCOW USSR. LIMITED SURFACE OBSERVATIONS CLIMATIC SUMMARY (LISOCS), PARTS A-F Data Summary, Sep. 1977 - Aug. 1987**
Nov. 1987 263 p
(AD-A188080; USAFETAC/DS-87/075) Avail: NTIS HC A12/MF A01 CSCL 04B

A statistical data summary of surface weather observation climatology: Moscow USSR. This summary is similar to the Revised Uniform Summary of Surface Weather Observations (RUSSWO), but is based on data collected from limited-duty weather observing stations; i.e., those that take weather observations less than 24 hours a day, 7 days a week. The summary is in five parts: PART 1, Weather Conditions and Atmospheric Phenomena; PART 2, Surface Winds; PART 3, Ceiling and Visibility, PART 4, Psychrometric Summaries; and PART 5, Pressure Summaries. Note that Part 2, Precipitation, is omitted. See USAFETAC/TN-83-001 (AD132186), An Aid For Using The Revised Uniform Summary of Surface Weather Observations (RUSSWO), for complete descriptions of contents and instructions for use. GRA

**N88-19047#** Sandia National Labs., Albuquerque, N. Mex.
**MISTY PICTURE WEATHER-WATCH AND MICROBAROGRAPH PROJECT: EXPERIMENTS 9412-14-18**
J. W. Reed, H. W. Church, and T. W. Huck 1987 123 p Presented at the Symposium for Misty Picture Event, Baltimore, Md., 7 Dec. 1987 Prepared in cooperation with Army Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-003949; SAND-87-2978C; CONF-871217-2) Avail: NTIS HC A06

Special meteorological observations and predictions for MISTY PICTURE are described. Ground zero measurements of winds and temperatures were used to develop predictions for needed light winds during the night for deployment of the helium bag for the

precursor experiment. This also entailed correlations with the White Sands network of automated surface observation stations as well as general circulation and upper air reports from the regional synoptic weather observing and reporting network. Pilot balloon observations of upper winds and Tethersonde observations were made during bag deployment to further document local circulation developments. During the test countdown, radiosonde balloon observations of upper air temperatures and winds were made to allow prediction of atmospheric effects on airblast propagation that could break windows to nearly 200 km range from the MISTY PICTURE explosion yield. These data indicated that there would be no strong off-site propagations on shot day, but at shot time the weak convergence zone in the shot area disturbed the wind pattern and generated a northwestward sound duct. Some banded airblast focusing resulted that gave relatively high overpressures just south of the Admin Park, at the Observer's Area, and in San Antonio where a number of windows were claimed broken. Relatively weak blasts, between caustics or foci, were recorded by microbarographs at Admin Park, Stallion, and Socorro. Very weak and barely detectable waves were propagated eastward to Carrizozo where MINOR SCALE had broken windows in 1985, and to the southeast toward Tularosa and Alamogordo. Five microbarograph stations were also operated around the west side of a 200 km radius circle, to document airblast waves ducted and focused by relatively high temperatures and easterly monsoon winds near 50 km altitudes. DOE

**N88-19048** Technische Univ., Hanover (West Germany). Inst. fuer Meteorologie und Klimatologie.
**AN ANALYTICAL METHOD FOR THE DETERMINATION OF THE AVERAGE HORIZONTAL WIND VELOCITIES ACROSS TWO-DIMENSIONAL HILLS Thesis [EIN ANALYTISCHES VERFAHREN ZUR BESTIMMUNG DER MITTLEREN HORIZONTALEN WINDGESCHWINDIGKEITEN UEBER ZWEIDIMENSIONALEN HUEGELN]**
Axel Michael Hoff 1987 74 p In GERMAN
(ISBN-3-923624-06-9; ISSN-0440-2820; ETN-88-91058) Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

An analytical model for the description of a thermally neutral boundary layer flow across flat two-dimensional hills was developed, using a modified two-layer concept of Jackson and Hunt. The most important difference with the theory of Jackson and Hunt is the small thickness of the internal boundary layer, as verified by observations. The effect of the horizontal pressure perturbation gradient was taken into account in the wind profile in a simple mathematical way. The resulting formalism permits the calculation of the horizontal wind velocity component at any place with a relatively small effort. A universal length scale, also used for the scaling of asymmetric hill profiles, is proposed. The effect of the thermal stratification on the flow field, and the problem of flow separation are discussed. The results of field experiments on real hills show good agreement with the analytical model. ESA

**N88-19049** Wisconsin Univ., Madison.
**DETERMINATION OF ATMOSPHERIC MOISTURE STRUCTURE FROM HIGH RESOLUTION MAMS RADIANCE DATA Ph.D. Thesis**
Gary Joseph Jedlovec 1987 182 p
Avail: Univ. Microfilms Order No. DA8720465

Radiance measurements from the Multispectral Atmospheric Mapping Sensor (MAMS) were used to diagnose low level moisture variations at the mesoscale. The MAMS is an airborne multispectral scanner which senses reflected visible and upwelling thermal energy from the earth and atmosphere. Two techniques were developed to utilize split window channel data in deriving precipitable water estimates in warm humid environments. The methods were evaluated on data collected during the COoperative Huntsville Meteorological Experiment (COHMEX) during which special rawinsonde and surface moisture measurements were made for verification. Results indicate that high resolution moisture variability can be detected with the remote measurements. Fluctuations of several millimeters of precipitable water were accurately determined. Case study analyses indicated that mesoscale gradients of precipitable water occurred at scales as fine as 5 km and could only be detected with high resolution MAMS data. Applicability of these methods to current satellite measurements and future satellite sensing systems are discussed. Dissert. Abstr.

**N88-19050** Oklahoma Univ., Norman.
**RETURN STROKE VELOCITIES AND CURRENTS USING A SOLID STATE SILICON DETECTOR SYSTEM Ph.D. Thesis**
Douglas Michael Mach 1987 104 p
Avail: Univ. Microfilms Order No. DA8725326

A small portable device was developed to measure lightning channel propagation velocities. The system consists of eight solid state silicon detectors mounted behind precision horizontal slits in the focal plane of a 50 mm lens on a 35 mm camera body. Each detector has a 0.1 deg vertical field of view that is separated from adjacent detector slits by 2.8 deg. The detector pulses, a timing signal, and slow and fast electric field change waveforms are recorded on a 14 track analog tape recorder with an upper frequency response of 1.0 MHz and a maximum dynamic interchannel timing error of 0.8 msec. The device, a television camera, and thunder microphone are installed parallel to each other atop a mobile laboratory, and permitting the recording of lightning signals at remote sites and while mobile. Analysis of 74 natural return strokes show that both natural and triggered flashes have the same average return stroke velocity of 1.2 + or - 0.2 x 100,000,000 m/s for channel lengths of over 500 m. This is within the range of previous values. Dissert. Abstr.

**N88-19051** Oklahoma Univ., Norman.
**OPTIMAL SAMPLING TO PROVIDE USER-SPECIFIC CLIMATE INFORMATION Ph.D. Thesis**
Suwanna Panturat 1987 272 p
Avail: Univ. Microfilms Order No. DA8725327

The types of weather related world problems which are of socio-economic importance selected as representative of three different levels of user groups include: (1) a regional problem concerned with air pollution plumes which lead to acid rain in the northeastern U.S.; (2) a state level problem in the form of winter wheat production in Oklahoma; and (3) an individual level problem involving reservoir management given errors in rainfall estimation at Lake Ellsworth, Oklahoma. Sampling networks were designed which are based on customer value systems and also abstracting from data sets the most cost effective information in reducing the climate sensitive aspects of a given user problem. Three process models being used to interpret climate variability in terms of the variables of importance to the user comprise: (1) the Heffter-Samson diffusion model as the climate transfer function for acid rain, (2) the Ceres-Maize plant process model for winter wheat production, and (3) the Agehyd streamflow model selected as a black box for reservoir management. A state of the art Non-Linear Program algorithm for minimizing an objective function is employed to determine the optimal number and location of various sensors. Dissert. Abstr.

**N88-19052*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**SUGGESTED SEVERE LOCAL STORM OPERATIONAL SCENARIO FOR GOES I-M**
William E. Shenk and Fredrick Mosher (National Severe Storms Forecast Center, Washington, D.C.) Nov. 1987 15 p
(NASA-TM-100688; Rept-88B0041; NAS 1.15:100688) Avail: NTIS HC A03/MF A01 CSCL 04B

The GOES I-M satellite system is expected to provide continuous high resolution estimates of temperature and moisture profiles, winds from cloud motions, surface temperature, cloud properties, and precipitation for severe local storm and tropical cyclone events. The suggested operational schedule for the GOES I-M satellite emphasizes the observation frequencies, spatial coverage, spectral bands, etc. for the GOES I-M imager and sounder instruments that are expected to optimize the determination of the relevant meteorological parameters. During severe local storm events, the imager would be programmed to

perform high frequency imaging (less than or= 3.5 min) for determining winds from cloud motions and for monitoring severe convection. In addition, the sounder would provide temperature and moisture profiles every hour over a 3000 X 3000 km domain during the antecedent stage or over a 1000 X 1000 km area every 10 minutes during the mature storm stage. Author

**N88-19053#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**MODEL OF LIMITED AREA OF 5 LAYERS FOR NUMERICAL WEATHER FORCASTING [MODELO DE AREA LIMITADA DE CINCO CAMADAS PARA PREVISAO NUMERICA DE TEMPO]**
Jose Carlos Rodrigues, Jose Luiz Stech, Jose Paulo Bonatti, Sergio Henrique Franchito, and Pedro Leiteda SilvaDias Sep. 1987 31 p In PORTUGUESE; ENGLISH summary
(INPE-4324-RPE/551) Avail: NTIS HC A03/MF A01

A primitive prognostic equation model, with horizontal spherical coordinates, and vertical sigma coordinates, was developed for use in numerical weather forecasting. The model programming has a modular structure that will easily allow the inclusion of the parameterizations of subgrid scale phenomena. The model has characteristics that attenuate computational effects and increase efficiency. The horizontal grid encloses all of South America, parts of Central America, and parts of adjacent oceans. The vertical grid has five layers, extending from surface up to 50 mb and a shallow lower layer intended for future boundary layer parameterization implementation. Radiational boundary conditions are used at eastern and western boundaries and zero meridional flux conditions at southern and northern boundaries. The model will be part of a complete operational scheme for weather forecasting. In order to verify the stability and performance of the model an experiment is made to simulate the circulation of the Bolivian High, which is generated by transient heat sources. The results show that the model is stable and has satisfactory performance for the examined case. Author

**N88-19054#** Wyoming Univ., Laramie. Dept. of Atmospheric Science.
**CLOUD PHYSICS STUDIES IN SCPP (SIERRA COOPERATIVE PILOT PROJECT) FROM 1977-87 Final Report**
J. D. Marwitz Oct. 1987 113 p
(Contract DI-2-07-81-V0256)
(PB88-136924; AS157) Avail: NTIS HC A06/MF A01 CSCL 04B

The cloud physics studies by the University of Wyoming investigators as participants in the Sierra Cooperative Pilot Project (SCPP) from 1977 to 1987 are summarized. The dynamic and precipitation processes are discussed in deep, stable orographic clouds; in deep, unstable orographic clouds; in shallow, stable orographic clouds; in shallow, unstable orographic clouds; in unstable rainbands; and in stable rainbands. The barrier jet and the Hallett-Mossop secondary ice crystal process are both ubiquitous in Sierra storms. GRA

# 48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

**N88-19055#** Coastal Engineering Research Center, Vicksburg, Miss.
**WAVE GROUP ANALYSIS BASED ON KIMURA'S METHOD Final Report**
Michael J. Briggs Sep. 1987 63 p
(AD-A187610; CERC-87-14) Avail: NTIS HC A04/MF A01 CSCL 08C

The computer program KIMUR5 was developed to predict wave group run lengths based on Kimura's method. This method, which is based on an assumption of mutual correlation between successive waves, has been demonstrated to be superior to Goda's method. Wave grouping is especially significant in shallow-water laboratory models of harbor resonance, beach runup, and slow-drift motions of moored structures. Descriptions, theoretical development, documentation, and a listing of the computer program KIMUR5 and associated subroutines are available on request. GRA

**N88-19056#** Woods Hole Oceanographic Institution, Mass.
**SEA DUCT: A DEEP-SEA COMPUTER-CONTROLLED RECIRCULATING FLUME FOR THE STUDY OF SEA FLOOR STABILITY Final Report**
Clifford L. Winget, Arthur R. Nowell, William E. Terry, and Allan G. Gordon Aug. 1987 220 p
(Contract N00014-85-C-0001)
(AD-A187734; WHOI-87-1) Avail: NTIS HC A10/MF A01 CSCL 08C

The Sea Duct Ocean-Bottom Laboratory is a computer controlled recirculating inverted flume for the in-situ study of sediment transport. It is designed to measure the sea floor response to controlled currents analogues to those generated by surface waves, tidal, or deep ocean storms. The external support frame is an equilateral triangle with sixteen foot sides. It is 12 feet high, has an air weight of 12,500 lbs., and 2800 lbs. submerged weight. Three lead-acid battery packs located at the vertex of the triangle legs provide power for the recirculating water pumps, hydraulic power, and ancillary equipment. The inner rotatable structure consists of a 4 foot long by 2 foot wide open bottom windowed test section that is 9 inches high. It is connected to 30 feet of 8 inch tube configured as an elongated toroid. Above the test section is a traverse carriage with stereo camera, flash, and a laser Doppler velocimeter to measure fluid stresses. Internal flow velocities are controlled and can be ramped up to approximately 2 ft/sec providing shear stress sufficient to scour sand, silts, and fine clays. Water and sediment sampling devices obtain specimens from inside and outside the test section. GRA

**N88-19057#** Woods Hole Oceanographic Institution, Mass.
**ESTIMATION OF SEA SURFACE WAVE SPECTRA USING ACOUSTIC TOMOGRAPHY Ph.D. Thesis**
James H. Miller Sep. 1987 176 p
(Contract N00014-87-K-0017)
(AD-A187837; WHOI-87-31) Avail: NTIS HC A09/MF A01 CSCL 08C

This thesis develops a new technique for estimating quasi-homogeneous and quasi-stationary sea surface wave frequency-direction spectra using acoustic tomography. The analysis of acoustic (mode and ray) phase and travel time perturbations due to a rough sea surface is presented. Two canonical waveguides (ideal shallow water and linear squared index of refraction) are used as examples for the mode perturbation. The analysis is used to explain high mode coherence measured in the FRAM IV experiment. The forward problem of computing the acoustic phase and travel time perturbation spectra given the surface wave spectrum is solved to first order. An application of the technique to ray phase data taken during the MIZEX '84 experiment is shown. The inverse problems for the homogeneous and quasi-homogeneous frequency-direction spectrum are introduced. The theory is applied to synthetic data which simulate a fetch-dependent sea. The estimates made agree well with the actual (synthetic data) spectrum. The effect of noise in the travel time estimates is studied. The sensitivity of the technique to the number of rays used in the inversion is investigated and the resolution and variance of the inverse method are addressed. GRA

**N88-19058** Maryland Univ., College Park.
**SPATIAL-TEMPORAL VARIABILITY OF NORTH PACIFIC SEA SURFACE TEMPERATURE ANOMALY PATTERNS Ph.D. Thesis**
John Albert Ernst 1987 310 p
Avail: Univ. Microfilms Order No. DA8725499

General Circulation Models were used in the diagnostic mode to assess the importance of the underlying initial boundary condition

under the hypothesis that North Pacific sea surface temperature anomalies are an important link in the teleconnective specification of downstream atmospheric weather patterns. The objectives of this study are: to specify the North Pacific sea surface temperature anomaly patterns over the period 1947 to 1983; to determine quantitatively the geographic distribution of the spatial-temporal variability associated with each type of anomaly pattern; and to assess the significance of the resultant type patterns in terms of cloud amount anomaly changes at selected geographic areas. An objective classification of seasonally composited gridpoint values of sea surface temperature anomalies was performed using linear correlation to identify 18 patterns in the North Pacific. The first five types were found to have comprised more than 62 percent of the total number of seasonal anomaly composite maps.
Dissert. Abstr.

**N88-19059** New South Wales Univ., Sydney (Australia).
**FIVE NEW SOUTH WALES BARRIER LAGOONS: THEIR MACROBENTHIC FAUNA AND SEAGRASS COMMUNITIES Abstract Only. Ph.D. Thesis**
Philip John Gibbs Dec. 1986 244 p
Avail: Issuing Activity

The distribution of sea grasses was determined in five lagoons: Queens Lake, Lake Macquarie, Lake Illawarra, Burrill Lake, and Merimbula Lake. The macrobenthic invertebrates were sampled in 1976 and 1977 at 15 sites in the 3 major sedimentary habitats, the marine sand entrance channel, the sublittoral fringe and the central mud basin of each lagoon. Temporal variability in the flora, nutrients, and fauna of the sublittoral fringe habitat of Merimbula Lake was assessed bimonthly over 3 years, 1978 to 1982. Hypotheses relating the biota of barrier lagoons to their geological evolution, biogeography, and coastal zone management are tested. The lagoons span the 2A type in the estuarine evolutionary model of Roy. Elements of the estuarine faunas have cosmopolitan, subtropical northern or cool to cold temperate southern distributions, which cross the boundaries of accepted biogeographic provinces defined for the southeastern Australian exposed rocky shores. A model relating estuarine faunal distribution patterns and offshore ocean currents is presented. Low level sewage enrichment in the sublittoral fringe of Merimbula Lake was compared with levels for the agricultural catchment. Bacteriological studies, however, indicated inadequate management of foreshore effluent disposal systems. Eutrophication is a future consequence for the lagoon.
Author

**N88-19060** New South Wales Univ., Sydney (Australia).
**MESOSCALE COASTAL OCEAN DYNAMICS Abstract Only Ph.D. Thesis**
David A. Griffin Nov. 1986 146 p
Avail: Issuing Activity

An analysis of observed circulation over the continental shelf and slope of the southern Great Barrier Reef (GBR), and a theoretical examination of wind driven flow in an infinite channel are presented. Current meters and water level recorders were deployed in the Capricornia section of the GBR from June to December, 1983. Tidal analyses of the hourly data set reveal an amplification of the semidiurnal tides as they propagate north-westward into the Capricorn Channel. The observed M sub 2 tidal heights and currents are in excellent agreement with the results of a barotropic numerical model. The longer period fluctuations of current, sea level, temperature, and wind stress are interpreted by comparison with coastal trapped wave (CTW) theories. Near-coastal currents and sea levels are modeled with some success by a theory of locally wind-forced barotropic continental shelf waves. Recorded temperatures and CTD data reveal that both tidal and longer period currents contribute to periodic upwelling onto the shelf. Secondly, the steady, wind driven, barotropic flow in long frictional channels of parabolic depth profile is examined analytically. Driven by spatially sinusoidal along-channel wind stress, the nature of the circulation depends mainly on the dimensionless channel width. The predicted steady wind driven circulation of Lake Ontario is in accord with observations.
Author

# 51 LIFE SCIENCES (GENERAL)

**N88-19061#** School of Aerospace Medicine, Brooks AFB, Tex.
**LASER FLASH EFFECTS ON CHROMATIC DISCRIMINATION IN MONKEYS Final Report, Apr. 1986 - Jun. 1987**
Elmar T. Schmeisser Oct. 1987 26 p
(AD-A187703; USAFSAM-TR-87-17) Avail: NTIS HC A03/MF A01 CSCL 06D

Detecting a camouflaged target in a visually noisy background depends on the ability of the observer to discriminate the target from the surrounding terrain. Visible laser irradiation at less than damage levels can act as a masking source by compromising or reducing the observer's ability to resolve differences in the visual scene. Previous research has examined this concept by investigating laser flash effects on: acuity (size discrimination); tracking (motion discrimination); visual sensitivity (color); and contrast sensitivity functions (luminance contrast). In all cases, flashes from continuous-wave (CW) sources have proven more effective visually than pulsed (Q-switched) sources, when compared on peak energy criterion (i.e., MPE), even though Q-switched lasers induce damage at lower energy doses. Additionally, the inherent safety of ultra-short laser pulses has been questioned. Past animal research has shown that, on the measures of acuity, sensitivity, tracking, and contrast detection, the animals recover to baseline if the exposure has remained below the MPE. The one measure that has not been investigated is color discrimination. The major conclusions from this investigation are: (1) red and green colored laser flashes shift the color balance transiently in the visual system, and yellow flashes do so to a lesser extent; thus targets may change both hue and brightness after an observer receives colored flashes; and (2) Q-switched lasers, at non-lesioning levels, when equated for time averaged perceptual brightness, have comparable effects to flashes with longer time courses.
GRA

**N88-19062#** Army Research Inst. of Environmental Medicine, Natick, Mass.
**CARBAMATES, ATROPINE, AND DIAZEPAM: EFFECTS ON PERFORMANCE IN THE RUNNING RAT**
Candace B. Matthew, Roger W. Hubbard, Ralph P. Francesconi, and Glenn J. Thomas 21 Oct. 1987 9 p
(AD-A188009) Avail: NTIS HC A02/MF A01 CSCL 06O

We have reported that when rats (500 g, male) are exercised to exhaustion on a treadmill, pretreatment with the centrally acting carbamate physostigmine reduced endurance (run time, RT) and increased the rate of rise of core temperature (Tc+). Both RT and Tc+ were restored to control levels by pretreatment with either or a combination of atropine (A), and diazepam (D). Our objective in the present work was to determine whether A+D could also restore the performance and thermoregulatory decrements induced by the peripherally acting carbamate pyridostigmine (PY). After drug administration, rats were run (11m/min, 60 elevation, Ta= 26 C) to exhaustion. PY treatment resulted in a reduced RT and an increased heat gain that neither A nor D alone (A+PY and D+PY) could restore to control levels. On the other hand, a combination of both A and D restored these variables to control levels. On the other hand, a combination of both A and D restored these variables to control levels. In conclusion, A+D can restore the performance and thermoregulatory decrements resulting from the administration of either a centrally or a peripherally acting carbamate.
GRA

**N88-19063#** Texas Univ. Health Science Center, Houston.
**PSYCHOPHYSICAL, BIOCHEMICAL AND HISTOLOGICAL STUDIES OF SPECTRALLY SELECTIVE PHOTIC DAMAGE TO PRIMATE RETINA Annual Report, Final Report, 1 Nov. 1982 - 1 Feb. 1987**
H. G. Sperling and A. A. Wright 25 Feb. 1987 38 p
(Contract DAMD17-83-C-3003; DA Proj. 3M1-61102-BS-10)
(AD-A188115) Avail: NTIS HC A03/MF A01 CSCL 06G

Spectral sensitivity and hue discrimination data are presented which show an irrecoverable loss of blue sensitive cone (B-cone) response following as little as 64. milliwatts per square cm of

458.5nm argon-ion laser exposure to rhesus monkey central retina over 4 hours of intermittent exposure. If reciprocity of intensity and exposure is linear, blue-blindness and attendant loss of discrimination colored signals could result from fewer than 240 brief exposures to blue laser light over a several hour period. Evidence is also shown for green lights. During the current contract period, success was obtained in destroying the B-cone response in single sessions under anaesthesia and in obtaining spectral sensitivity measures from the focal ERG which are sufficiently stable and detailed to measure the response of R-, G- and B-cones, rods and the interactions between them. Evidence is presented, from the focal ERG, that the color-opponent type neural inhibition exists in rhesus, as in fish and amphibia, in the out-plexiform layer of the retina, since it is detectable in the late receptor potential (a-wave). GRA

**N88-19064#** Science Applications International Corp., McLean, Va.
**CRITICAL PHENOMENA AND ELECTROMAGNETIC EFFECTS IN BIOLOGICAL MEMBRANES Annual Report, Nov. 1986 - Oct. 1987**
James D. Bond, N. C. Wyeth, and Carol A. Jordan 30 Oct. 1987 12 p
(Contract N00014-83-C-0008; Proj. RR0-4108)
(AD-A188156; SAIC-87/1167) Avail: NTIS HC A03/MF A01 CSCL 06J

A physical basis is established whereby external electromagnetic fields can interact with biological membranes. The mechanism discussed, based on the membrane residing in a thermodynamic state near critical point, can accommodate very low field strengths. Numerical estimates of field strengths required to drive the membrane system close enough to a critical point, assuming it does not initially reside there, are presented. GRA

**N88-19065** New South Wales Univ., Sydney (Australia).
**MOTOR CONTROL IN MAN AND MONKEY Abstract Only. Ph.D. Thesis**
J. G. Colebatch Nov. 1986 211 p
Avail: Issuing Activity

Aspects of motor control were studied in both human subjects and monkeys. Normal subjects were tested for their ability to keep constant either the position of the arm or the force exerted without external feedback. There was a period prior to conscious awareness of the applied disturbance during which stiffness due to intrinsic muscle properties plus reflex responses to stretch were measured. The relative strength of elbow extension and flexion on the normal and weak sides of hemiparetic patients were compared. It was found that the flexors were relatively more weakened that the extensors. Two monkeys were trained to accept percutaneous vibration over muscle tendons and one of them also to accept tendon percussion. The effects of these stimuli on individual precentral neurons was compared with the effects of passive movement. Neurons excited by passive elbow flexion or extension were equally likely to respond to vibration or percussion of the triceps tendon. This lack of selectivity may account for some of the properties of the long-latency reflex response to stretch. In the final series of experiments a cooling plate was implanted over area 2 of the postcentral gyrus of a monkey, thus allowing synaptic transmission to be blocked reversibly. Short-latency excitation of area-4 neurons from passive limb movements was not affected by cooling, indicating that cortico-cortical afferents from area 2 were not responsible. The general implication of these findings and possible further investigations are discussed. Author

**N88-19066*#** National Aeronautics and Space Administration, Washington, D.C.
**GENETIC RESEARCH IN SPACE**
N. L. Delone, V. V. Antipov, and Ye. A. Ilyin Mar. 1988 10 p Transl. into ENGLISH of Geneticheskiye Issledovaniya v Kosmose (Moscow, USSR), Inst. for Medical-Biological Problems, Ministry of Health USSR, Scientific Council, 1987 p 1-11 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20216; NAS 1.77:20216) Avail: NTIS HC A02/MF A01 CSCL 06B

The role of the genetic apparatus in the adaptation of the organism to conditions of weightlessness is studied. The investigation includes studies at the gene, chromosome, cell, tissue, and organism levels, as well as studies at the population level. Author

# 52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**N88-19067*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**HEMOLYSIS IN RUNNERS AS EVIDENCED BY LOW SERUM HAPTOGLOBIN: IMPLICATIONS FOR PREFLIGHT MONITORING OF ASTRONAUTS**
Joyce Owens, Diane L. Spitler, and Mary Anne Bassett Frey Aug. 1987 16 p Prepared in cooperation with Bionetics Corp., Cocoa Beach, Fla.
(Contract NAS10-10285)
(NASA-TM-100304; NAS 1.15:100304) Avail: NTIS HC A03/MF A01 CSCL 06P

Hematological parameters and serum haptoglobin were examined in 21 male employees of the Kennedy Space Center who were at 3 levels of physical activity: 7 subjects regularly ran more than 40 km (25 miles) per week (Group I); 7 ran 13 to 24 km (8 to 15 miles) per week (II), and 7 were sedentary (III). Blood was drawn on a different day of the week for five weeks. Differences between day of the week, visit number, and activity level were examined. No differences were observed for day of week or visit number; thus mean values for each variable were calculated for each subject. Variables did not differ among groups. However, trends with level of training were observed in some critical variables. Hemoglobin (Hb) and hematocrit (Hct) conformed to a staircase effect with Group I (14.5 gm/dl and 41.3 percent) lower than Group III (15.1 gm/dl and 42.9 percent). Reticulocyte count was higher and haptoglobin levels lower in Group I (1.35% and 75.7 gm/dl) than Group III (.99 percent and 132.9 gm/dl), with haptoglobin for the high mileage Group I in the clinically abnormal range. Since haptoglobin binds free Hb following RBC destruction, these results suggest that intravascular hemolysis occurs in trained male runners. These results may have special meaning for astronauts training before long-duration spaceflights, since the further reduction in red blood cells which is reported to occur during spaceflight could become detrimental to their health and performance. Author

**N88-19068#** California Univ., Berkeley. Dept. of Physiology-Anatomy.
**CENTER FOR NONLINEAR DYNAMICS OF THE BRAIN Final Report, 31 Jul. 1986 - 30 Sep. 1987**
Walter Freeman 30 Sep. 1987 4 p
(Grant AF-AFOSR-0271-86)
(AD-A187245; AFOSR-87-1565TR) Avail: NTIS HC A02/MF A01 CSCL 05H

The Center for Nonlinear Dynamics of the Brain (CNDB) studies nonlinear dynamics of large masses of nerve cells in animal and human brains as the basis for explaining the self-organization of goal-directed cognitive behaviors. We believe that this approach to the study of mass neural action will be a basic method of the neurophysiology of the twenty-first century. Our research has application to clinical neurology and psychiatry, to the measurement and enhancement of human mental capabilities and to the design of self-organizing, pattern recognition computer systems. By extending techniques and models derived from the paleocortex to animal and human neocortex, deeper understanding of the neural basis of goal-directed higher brain functions will emerge. The practical consequences of this enhanced knowledge will be better diagnosis of neurologic and psychiatric diseases. It also will result

in the ability to predict decrements in higher brain functions consequent to illness, fatigue or drugs. The new models for globally parallel, self-organizing systems which result from this research also will be directly relevant to the design of VLSI architectures for pattern recognition. GRA

**N88-19069#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**MANIPULATION OF MUSCLE GLYCOGEN CONCENTRATIONS USING HIGH AND LOW CARBOHYDRATE DIETS AND EXERCISE Final Report, Aug. 1986 - Jan. 1987**

Joan C. Buchbinder, Julie Pocost, Lisa A. Hodgess, Edward T. Roche, and Madeleine S. Rose 31 Aug. 1987 57 p

(AD-A187732; USARIEM-T-32/87) Avail: NTIS HC A04/MF A01 CSCL 06J

The Influence of Muscle Glycogen Levels on Shivering and Temperature Regulation During Cold Water Immersion study was designed to investigate the effect of muscle glycogen levels on body temperature homeostasis in man acutely exposed to cold, with alterations in muscle glycogen levels experimentally induced by exercise and dietary manipulation. The results of muscle biopsies taken from each test subject after each phase indicated that the exercise and dietary manipulation were effective in depleting muscle glycogen concentrations as well as repleting levels above what would be expected as normal concentrations in untrained subjects. The results of the dietary efforts supported the findings of other investigators that muscle glycogen levels can be increased by consumption of a high carbohydrate diet (in conjunction with a reduction of physical exercise), without necessarily having to stimulate the muscle for supercompensation via a depletion phase immediately preceding the loading phase as has been recommended for glycogen loading in the past. A series of practical high and low carbohydrate diets were developed using foods that can be easily obtained from commercial supermarket sources. These diets require minimal preparation and can be effectively utilized in metabolic ward studies or by athletes preparing for endurance events requiring replete muscle glycogen levels prior to completion. GRA

**N88-19070#** Illinois Univ., Chicago. Coll. of Medicine.

**ROLE OF ADENOSINE ANALOGS AND GROWTH HORMONE IN WAKING AND SLEEP Annual Report, 15 Sep. 1986 - 15 Sep. 1987**

Miodrag Radulovacki 16 Oct. 1987 5 p

(Grant AF-AFOSR-0349-85)

(AD-A187897; AFOSR-87-1687TR) Avail: NTIS HC A02/MF A01 CSCL 06O

The role of adenosine in sleep has been further investigated using electroencephalography to document the dose response effects of newly developed specific adenosine A1 and A2 receptor stimulants and 8-cyclopropyltheophylline (CPRT), a substituted xanthine. The results with adenosine agonist suggest that both A1 and A2 receptors play a role in the hypnotic action of adenosine. The data with CPRT point out that stimulant effects of xanthines is obtained by the blockade of A1 receptors. Densensitization of adenosine A2 receptors was found following the chronic treatment of adenosine agonists L-PIA, NECA ad deoxycoformycim. Chronic administration of caffeine up-regulates A1 receptors in cerebral cortex in a manner similar to that following deprivation of REM sleep. This suggests the existence of an endocaffeine whose normal role is to block adenosine receptors during prolonged sleep deprivation- a mechanism that could be responsible for the increased number of adenosine receptors. GRA

**N88-19071#** Smith-Kettlewell Inst. of Visual Sciences, San Francisco, Calif. Eye Research Foundation.

**VISUAL EVOKED POTENTIALS Annual Technical Report, 1 Sep. 1986 - 31 Aug. 1987**

Ken Nakayama 3 Nov. 1987 5 p

(Grant AF-AFOSR-0320-83)

(AD-A187942; AFOSR-87-1831TR) Avail: NTIS HC A02/MF A01 CSCL 06D

Progress over the past year has been rapid and wide ranging, covering two primary areas. First, in the area of visual attention, we have shown both the existence of a sustained and a transient component of enhanced pattern recognition. This cannot be explained by visual transients or eye movements. Second, we have examined a wide range of issues related to partial visibility (occlusion) using stereoscopic displays. In particular, we have shown that pattern recognition of partially hidden objects is superior if the pattern is in a rear vs. front stereoscopic plane, that the solution to the aperture problem for motion is dictated by whether line terminators are seen as real terminators or the result of occlusion by other surfaces, and finally, we have shown that the depth interpretation of untextured stereograms requires that the visual system classify edges before evaluating their depth. GRA

**N88-19072#** Northrop Services, Inc., Dayton, Ohio. Environmental Sciences.

**TOXIC EFFECTS OF MAN-MADE MINERAL FIBERS WITH PARTICULAR REFERENCE TO CERAMIC FIBERS Technical Report, Dec. 1986 - Jan. 1987**

Allen Vinegar Sep. 1987 33 p

(Contract F33615-85-C-0532)

(AD-A187949; AAMRL-TR-87-045; NMRI-87-40) Avail: NTIS HC A03/MF A01 CSCL 06K

In order to evaluate the potential hazards of man made mineral fibers (MMMF); particularly ceramic fibers, in the Navy work environment, the following areas are considered. First, the current standards and recommendations of other agencies are presented as an overview of current concensus as to relative hazards of asbestos, MMMF, and cristobalite (a form of crystalline silica). Then, a summary of recent epidemiological evidence is presented. These data should be the most relevant for human exposure. Unfortunately, there are no data for workers in the ceramic fiber field. Then a review is presented of the data from animal experiments which employed exposure by inhalation, intratracheal instillation, and intrapleural or intraperitoneal injection. The experiments reviewed involve only non-ceramic MMMF. Some detail of the protocol and results of each experiment are presented to provide a better understanding of the non-uniformity of the protocols used. Another issue of particular importance in understanding fiber toxicity is the durability of the fiber. These data are presented for non ceramic MMMF. GRA

**N88-19073#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**GASTRIC EMPTYING DURING EXERCISE: EFFECTS OF ACUTE HEAT STRESS, ACCLIMATION AND HYPOHYDRATION**

P. D. Neufer, Andrew J. Young, and Michael N. Sawka Oct. 1987 31 p

(AD-A188008) Avail: NTIS HC A03/MF A01 CSCL 06J

To determine the effects of acute heat stress, heat acclimation and hypohydration on the gastric emptying rate of water (W) during treadmill exercise, ten physically fit men ingested 400 ml of W prior to each of three 15-min bouts of exercise (treadmill, about 50 percent VO2 max) on five separate occasions. Stomach contents were aspirated after each exercise bout. Before heat acclimation (ACC), experiments were performed in a neutral (18 C), hot (49 C) and warm (35 C) environment. Subjects were euhydrated for all experiments before ACC. After ACC, the subjects completed two more experiments in the warm (35 C) environment; one while euhydrated and a final while hypohydrated (5 percent of body weight). The volume of ingested water emptied into the intestines were inversely correlated (P is less than 0.01) with the rectal temperature ($r=0.76$) and heart rate ($r=0.88$) at the completion of each exercise bout. The following new observations were made: (1) exercise in a hot (49 C) environment impairs gastric emptying rate as compared to a neutral (18 C) environment; (2) exercise in a warm (35 C) environment does not consistently affect gastric emptying before or after heat acclimation; but (3) exercise in a warm environment when hypohydrated reduces gastric emptying rate. Reductions in gastric emptying appeared to be related to the severity of the thermal and cardiovascular strain induced by exercise/heat stress. GRA

**N88-19074#** Army Research Inst. of Environmental Medicine, Natick, Mass.
**DEVELOPMENT OF A COPING STRATEGIES QUESTIONNAIRE TO ASSESS ENDURANCE PERFORMANCE**
William J. Tharion and Alyssa L. Terry 16 Oct. 1987 7 p
(AD-A188010) Avail: NTIS HC A02/MF A01 CSCL 06J

The purpose of this study was to develop a questionnaire to assess coping strategies employed to help combat the physical and psychological stress associated with endurance activities. When assessing the performance of two individuals trained similarly for a sustained operation (an operation lasting longer than six hours) or other endurance related tasks, a question that often arises is why is one individual able to complete the mission or task while his similarly trained partner is unable to do so. This question is also frequently examined in the athletic arena, especially for long endurance events. In all of these cases, psychological explanations are often given to explain why one individual is able to successfully cope with the demands of the activity and finish it, while another individual is not able to. Understanding how successful soldiers and athletes cope with the stresses involved in endurance events should allow for a better understanding of superior performance. GRA

**N88-19075#** Army Research Inst. of Environmental Medicine, Natick, Mass.
**OPERATION EVEREST 2: ALTERATIONS IN THE IMMUNE SYSTEM AT HIGH ALTITUDE**
Richard Meehan, Ulric Duncan, Laureen Neale, Gerald Taylor, and Harold Muchmore 9 Sep. 1987 42 p
(AD-A188011) Avail: NTIS HC A03/MF A01 CSCL 06E

We investigated the effects of progressive hypobaric hypoxia simulating an ascent to 25,000 ft (7,620m) over 4 weeks on immune function. Multiple simultaneous in vitro and in vivo immunologic parameters were obtained from 7 subjects at sea level, 7,500 ft (2,286m), and 25,000 ft during a decompression chamber exposure. PHA stimulated thymidine uptake and protein synthesis in mononuclear cells were reduced at extreme altitude. An increase in monocytes without changes in B cells or T cell subsets was also observed by flow cytometry analysis. Plasma IgM and IgA but not IgG levels were increased at altitude, whereas PWM stimulated in vitro IgG, IgA and IgM secretion was unchanged. In vitro PHA stimulated interferon production and NK cytotoxicity did not change statistically but large inter-subject differences were observed during exposure to 25,000 ft. Nasal wash IgA and lysozyme levels, and serum antibodies to nuclear antigens were not influenced by altitude exposure. These results suggest that T cell function is blunted during exposure to severe hypoxemia, whereas B cell function and mucosal immunity are not. While the mechanism of altered in vitro immune responsiveness following exposure to various environmental stressors has not been elucidated in humans, hypoxia may induce immune dysfunction as suggested by in vitro immune effector cell function assays. GRA

**N88-19076#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**VISUAL INTEGRATION AND DETECTION OF DISCONTINUITIES: THE KEY ROLE OF INTENSITY EDGES**
Ed Gamble and Tomaso Poggio Oct. 1987 34 p
(Contract N00014-85-K-0124)
(AD-A188012; AI-M-970) Avail: NTIS HC A03/MF A01 CSCL 06C

Integration of several vision modules is likely to be one of the keys to the power and robustness of the human visual system. The problem of integrating early vision cues is also emerging as a central problem in current computer vision research. This paper suggests that integration is best performed at the location of discontinuities in early processes, such as discontinuities in image brightness, depth, motion, texture and color. Coupled Markov Random Field models, based on Bayes estimation techniques, can be used to combine vision modalities with their discontinuities. These models generate algorithms that map naturally onto parallel fine-grained architectures such as the Connection Machine. A scheme was derived to integrate intensity edges with stereo depth and motion field information and show results on synthetic and natural images. The use of intensity edges to integrate other visual cues and to help discover discontinuities emerges as a general and powerful principle. GRA

**N88-19077#** Veterans Administration Hospital, San Francisco, Calif.
**NEUROPEPTIDES IN EXPERIMENTAL HEAD INJURY Annual Report, 1 Mar. 1986 - 28 Feb. 1987**
Alan I. Faden and Tracy K. McIntosh 28 Feb. 1987 39 p
(DA Proj. 3S1-62772-A-874)
(AD-A188067) Avail: NTIS HC A03/MF A01 CSCL 06E

Much of the damage resulting from ischemic or traumatic insults to the central nervous system appears to result from secondary injury mechanisms relating to the release of endogenous factors. Endogenous opioids may represent one such class of pathophysiological factors, and have been implicated in traumatic spinal cord injury, ischemic spinal cord injury and ischemic brain injury. The studies covered under the present contract examine the potential pathophysiological role of endogenous opioids and their receptor-mediated changes following traumatic brain injury in both cats and rats. Utilizing a fluid percussion device we have evaluated the effects of graded levels of injury on outcome measures, including mean arterial pressure, intracranial pressure, electroencephalographic (EEG) activity, and cerebral blood flow in the cat. In a continuation of studies begun during the first year of the present contract, we have compared the effectiveness of the opiate antagonist WIN44, 441-3, which has enhanced activity at the kappa-opiate receptor, with its inactive stereoisomer WIN44, 441-2, saline, and dopamine hydrochloride. Finally, we have initiated pilot studies utilizing nuclear magnetic resonance spectroscopy (MRS) to evaluate the dynamic in vivo metabolic response to traumatic brain injury in the rat. These studies have shown that transient changes in high energy phosphates and intracellular pH occur in response to traumatic brain injury. This decreased PCr/Pi ratio in the absence of hypoxis or tissue acidosis may be a reflection of mitochondrial dysfunction and may thus be a marker of irreversible tissue injury. GRA

**N88-19078#** Northeastern Univ., Boston, Mass.
**CENTER FOR THE STUDY OF RHYTHMIC PROCESSES Annual Report, 1 Oct. 1986 - 1 Oct. 1987**
Nancy Kopell, Avis H. Cohen, Eve Marder, and Karen A. Sigvardt 20 Oct. 1987 36 p
(Contract F49620-87-C-0013)
(AD-A188204; AFOSR-87-1657TR) Avail: NTIS HC A03/MF A01 CSCL 06D

The Center for the Study of Rhythmic Processes began operation in the academic year 1986 to 1987. It brought together mathematicians and biologists to work on problems of mutual interest. During the first year, the Center focused on two sets of problems. The first involved the structure and function of the intersegmental coordinating system of the vertebrate spinal cord, for which the lamprey provides an excellent model system. A broadly applicable mathematical framework was constructed for analyzing this system, and new mathematical techniques were invented. A new technology was put into use which has the potential of providing information not previously obtainable. Many of the major researchers working on this preparation were consolidated under the auspices of the center, and many new collaborations were formed. The other involved small neural networks, such as the stomatogastric ganglion of the lobster. Detailed mechanisms of function and control were investigated, and mathematical tools were applied to investigate how the circuits change under modulation. GRA

**N88-19079#** Joint Publications Research Service, Arlington, Va.
**JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES**
12 Feb. 1988 65 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-88-001) Copyright Avail: NTIS HC A04/MF A01

Articles and summaries of articles from the open literature are presented in the areas of aerospace medicine, agricultural science, biochemistry, biotechnology, epidemiology, genetics, laser bioeffects, microbiology, molecular biology, pharmacology and toxicology, physiology, public health, radiation biology, and virology. For individual titles, see N88-19080 through N88-19081.

**N88-19080#** Joint Publications Research Service, Arlington, Va.
**BALLISTOCARDIOGRAPHY IN WEIGHTLESSNESS RESEARCH Abstract Only**
R. M. Bayevskiy, I. I. Funtova, and M. D. Zakatov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 12 Feb. 1988 p 1 Transl. into ENGLISH from Vestnik Akademii Meditsinskikh Nauk SSSR (Moscow, USSR), no. 6, Jun. 1987 p 77-84 (For primary document see N88-19079 11-52)
Avail: NTIS HC A04/MF A01

A review is presented of advances in ballistocardiographic studies during weightlessness aboard Salyut-6 and -7 space ships, as well as in controlled ground experimentation. The latter involved ten 19 to 20-year-old males subjected to antiorthostatic kinesia for prolonged periods of time to simulate weightlessness. In general, the results of both series were in agreement. Over a 90-day period three basic phases of changes in cardiac contractility were identified. The initial stage was a diminished mechanical activity of the right heart. The second stage consisted of enhanced contractility of the right ventricle with simultaneous reduction in the contractility of the left heart. The final stage was a reversal of the phenomenon in the second stage, i.e., enhanced contractility of the left ventricle with concomitant reduction in contractility of the right heart. Further developments in ballistocardiographic techniques and equipment will lead to an expanded use of this technology in clinical medicine, following its initial development for space physiology. Author

**N88-19081#** Joint Publications Research Service, Arlington, Va.
**CENTRAL HEMODYNAMICS IN ANTIORTHOSTATIC HYPOKINESIA AND IMMERSION MODELS OF WEIGHTLESSNESS Abstract Only**
V. Ye. Katkov, L. I. Kakurin, V. V. Chestukhin, and E. M. Nikolayenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 12 Feb. 1988 p 2 Transl. into ENGLISH from Vestnik Akademii Meditsinskikh Nauk SSSR (Moscow, USSR), no. 6, Jun. 1987 p 71-77 (For primary document see N88-19079 11-52)
Avail: NTIS HC A04/MF A01

A comparative study was conducted on the physiological effects of antiorthostatic hypokinesia (15 deg body angle) and dry immersion on central hemodynamics in weightlessness simulation research. The experiments were conducted over a period of 7 days with 17 healthy males (33 years old) divided into two groups. The central hemodynamic parameters were more affected by immersion ir: the initial hours of the experiment, presumably due to the primary effects of immersion. Stabilization of the various hemodynamic parameters was seen in 2 to 3 days in both experiments, and within 7 days there were no significant differences between the groups. These observations were interpreted to indicate that both experimental approahces lead to essentially identical data on the effects of weightlessness and are equally suitable for onboard experimentation in space stations. This is particularly applicable to monitoring of central venous pressure, whereas the other hemodynamic parameters still require additional studies. Within 1 day of the experiment the central venous pressure fell from a control value of 4.1 mmHg to 2.1 mmHg, decreasing to 1.7 mmHg by day 7. Similar results had been obtained aboard Space Lab-1. Author

**N88-19082#** South African Association of Physicists in Medicine and Biology, Pretoria.
**SOUTH AFRICAN ASSOCIATION OF PHYSICISTS IN MEDICINE AND BIOLOGY: 26TH ANNUAL CONGRESS**
1986 48 p In AFRIKAANS and ENGLISH Congress held at Pretoria, South Africa, 18 Mar. 1986
(DE88-700824; INIS-mf-11084; CONF-8603229) Avail: NTIS (US Sales Only) HC A03/MF A01

The Twenty-Sixth Annual Congress of the South African Association of Physicists in Medicine and Biology was held from 18 to 26 March 1986 in Pretoria. Papers delivered covered subjects like medical physics, radiotherapy, radiation protection, calibration of radiation monitors, radiation detectors, radiation doses and dosimetry. DOE

**N88-19083** New South Wales Univ., Kensington (Australia). School of Mechanical and Industrial Engineering.
**CAUSES AND PREVENTION OF OCCUPATIONAL REPETITION STRAIN INJURIES (RSI) Abstract Only. Ph.D. Thesis**
Keshaba N. Baidya 1986 494 p
Avail: Issuing Activity

The incidence of repetition strain injuries (RSI) has greatly increased in recent years. There is no effective treatment. To prevent RSI, it is essential to understand the causes, and then to develop guidelines for work design based on the causes. The statistics indicated a correlation between RSI cases and the extent of industrialization. It was shown that females are more prone to RSI than males. To help in identifying causes of RSI, a survey was designed to correlate personal and work factors associated with the incidence of RSI. The survey of a sufferer and control group showed that the members of the sufferer group tended to be heavier, to spend more of their leisure time in indoor activities, to be in their thirties and to be engaged in more tense, repetitive work at a less adjustable pace than their counterparts. Local Muscle Fatigue (LMF) is considered to be a common precursor of RSI. The power density spectrum of EMG signals from the muscles concerned was shown to be the best indicator of LMF. The center frequency of the spectrum decreases with fatigue. To examine causes of fatigue, EMG signals of the extensor muscles were examined during repetitive wrist extension against a load. The degree of wrist extension, ulnar deviation during extension and the sex of the operator were the variable factors in the first experiment. In the second experiment, the rest period after half an hour exercise was varied, with the other variables fixed. Alternative methods were compared and the results supported the use of EMG frequency analysis for measuring LMF. Author

**N88-19084#** Health Effects Research Lab., Research Triangle Park, N. C.
**EFFECTS OF BREATHING AIR CONTAINING CONTAMINANTS SUCH AS CO2, CO AND HYDROCARBONS AT 1 AND 5 ATMOSPHERES**
V. A. Benignus Nov. 1987 69 p
(PB88-132915; EPA-600/D-87/348) Avail: NTIS HC A04/MF A01 CSCL 06T

The neural and behavioral effects of air contaminants such as CO2, CO and hydrocarbons are reviewed. Each contaminant or contaminant class is reviewed separately and then an attempt is made to estimate effects of combinations of contaminants. The effects are reviewed for both normobaric and hyperbaric conditions. Rough dose effects curves were constructed from data found in the literature. Author

**N88-19085*#** National Aeronautics and Space Administration, Washington, D.C.
**REGULATION OF CALCIUM METABOLISM DURING PROLONGED ANTIORTHOSTATIC HYPOKINESIA**
A. I. Grigoryev, B. V. Morukov, B. R. Dorokhova, and L. A. Rustamyan Mar. 1988 11 p Transl. into ENGLISH from Fiziologiya Cheloveka, Akademiya Nauk SSSR (Moscow, USSR), v. 7, Jul. - Aug. 1981 p 705-709 Original language document was announced in IAA as A81-44897 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20219; NAS 1.77:20219) Avail: NTIS HC A03/MF A01 CSCL 06S

Characteristics of the regulation of calcium exchange in healthy persons exposed to 182 days of antiorthostatic hypokinesia are investigated. Total calcium concentrations, ionized calcium activities

and parathyroid hormone concentrations in blood serum were determined, before, during, and up to 15 days after a 182-day period of strict bed rest at a head down tilt of 4 deg; and tests of blood urine responses to a calcium lactate stress were performed to study the role of the kidneys. An increase in calcium ion activity is observed during the period of hypokinesia, while total calcium concentrations changed to a lesser degree. Plasma parathyroid hormone levels are found to significantly exceed background levels during hypokinesia and in the recovery period immediately following. Finally, the increase in calcium excretion in the urine during prolonged limitations of muscular activity is found to be connected with both an enhancement of calcium filtration and a decrease in its reabsorption in the kidneys, possibly due to changes in hormonal regulation. Author

# 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N88-19086*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**SUMMARY OF PAYLOAD INTEGRATION PLAN (PIP) FOR STARLAB-1 FLIGHT EXPERIMENT, ENCLOSURE 3**

Patricia S. Cowings, W. Toscano, J. Kamiya, N. Miller, and J. Sharp [1988] 8 p

(Contract NCC2-115)

(NASA-TM-89713; NAS 1.15:89713) Avail: NTIS HC A02/MF A01 CSCL 05I

The objectives of the Autogenic Feedback Training (AFT) are to: determine if preflight AFT is an effective treatment for space adaptation syndrome (SAS); determine if preflight improvements in motion sickness tolerance can be used to predict crewmembers' success in controlling symptoms in flight; and identify differences and similarities between the physiological data from preflight motion sickness tests and data collected during symptom episodes in space. The goal is to test the AFT on 8 trained and 8 control subjects. At present 2 trained and 2 contol subjects were tested. The testing will continue until the experimental goal of testing 16 individual is reached. B.G.

**N88-19087#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

**RESEARCH IN KNOWLEDGE REPRESENTATION FOR NATURAL LANGUAGE COMMUNICATION AND PLANNING ASSISTANCE Annual Report, 16 Mar. 1986 - 31 Mar. 1987**

Bradley A. Goodman, A. Haas, E. Hinrichs, H. Kautz, and L. Polanyi Oct. 1987 116 p

(Contract N00014-85-C-0079; ARPA Order 3414)

(AD-A187355; BBN-6636) Avail: NTIS HC A06/MF A01 CSCL 05G

BBN's DARPA project in Knowledge Representation for Natural Language Communication and Planning assistance has two primary objectives: (1) To perform research on aspects of the interaction between users who are making complex decisions and systems that are assisting them with their task. In particular, this research is focused on communication and the reasoning required for performing its underlying tasks of discourse processing, planning and plan recognition and communication repair; and (2) Based on the research objectives, to build tools for communication, plan recognition, and planning assistance and for the representation of knowledge and reasoning that underlie all of these processes. This report summarizes BBN's second year's activity in research in knowledge representation and natural language. In particular, the report discusses work in the areas of knowledge representation, planning, and discourse modeling. GRA

**N88-19088#** Massachusetts Univ., Amherst. Dept. of Computer and Information Science.

**TWO ATTENTIONAL MODELS OF CLASSICAL CONDITIONING: VARIATIONS IN CS EFFECTIVENESS REVISITED Technical Report**

Nestor A. Schmajuk and John W. Moore 3 Apr. 1987 35 p

(Grant AF AFOSR-0182-86)

(AD-A187697; COINS-TR-87-29; AFOSR-87-1681TR) Avail: NTIS HC A03/MF A01 CSCL 05H

Attentional models offer alternatives for describing blocking, overshadowing, and many other features of classical conditioning. Two such models emphasize variations in the associability of CSs instead of variation in the effectiveness of the reinforcing event, the US. Early published variants do not always accurately portray the effects of nonreinforced CS presentations as represented in simulation experiments. In one case levels of conditioned responding under partial reinforcement are too low to reasonably approximate expectations based on the experimental literature, and extinction is too deep to produce the rapid reacquisition that typically follows extinction. These problems are corrected by changing the expressions in the model for decreasing associative strength. The revised model retains the positive features of the original, e.g., the ability to stimulate in real-time latent inhibition and compound CS effects such as blocking and conditioned inhibition. The other model is path dependent and highly nonlinear under partial reinforcement. The problem can be corrected either by modifying and restricting the rules for computing the associability of the CS, or by modifying the rules for computing associative strength. The revised model retains the original's ability to simulate latent inhibition, compound CS effects, and the transfer (positive or negative) from training with a weak US to training with stronger US. GRA

**N88-19089#** Dayton Univ., Ohio. Research Inst.

**VISUAL CONTRAST SENSITIVITY FUNCTIONS OBTAINED FROM UNTRAINED OBSERVERS USING TRACKING AND STAIRCASE PROCEDURES Final Technical Report, Oct. 1985 - Apr. 1987**

George A. Geri and David C. Hubbard Nov. 1987 26 p

(Contract F33615-84-C-0066)

(AD-A187715; AFHRL-TR-87-26) Avail: NTIS HC A03/MF A01 CSCL 06D

Two adaptive psychophysical procedures (tracking and yes-no staircase) for obtaining human contrast sensitivity functions (CSFs) were evaluated. The procedures were chosen based on their proven validity and our desire to evaluate the practical effects of stimulus transients, since tracking procedures traditionally employ gradual stimulus onsets whereas staircase procedures traditionally employ rapid stimulus onsets. The criteria for deciding which procedure was preferable for the rapid testing of large groups of untrained observers were consistent in the form of the measured CSFs across days, the subjective ease of the as judged by the observer, and the time required to obtain consistent results. Both procedures gave repeatable results across days; thus, the first CSF obtained from each subject could be taken as representative of the true CSF as determined by additional testing. However, the tracking procedure was judged easier to use by the present observers and required less time to perform. No interaction was found between any of these variables and the different stimulus onset parameters of the two procedures. GRA

**N88-19090#** Illinois Univ., Urbana. Model Based Measurement Lab.

**MODELING INCORRECT RESPONSES TO MULTIPLE-CHOICE ITEMS WITH MULTILINEAR FORMULA SCORE THEORY**

Fritz Drasgow, Michael V. Levine, Bruce Williams, Mary E. McLaughlin, and Gregory Candell Aug. 1987 117 p

(Contracts N00014-83-K-0397; N00014-86-K-0482; Proj. RR0-4204)

(AD-A187887; MEASUREMENT SER-87-1) Avail: NTIS HC A06/MF A01 CSCL 05H

Multilinear Formula Score theory provides powerful methods for solving psychological measurement problems of long standing.

In this paper the question of information in incorrect option selection on multiple choice items is addressed. Multilinear formula scoring (MFS) is first used to estimate option characteristic curves for the Armed Services Vocational Aptitude Battery Arithmetic Reasoning test. Accurately estimated curves are obtained for real and simulated data. Then the statistical information about ability is computed for dichotomous and polychotomous scorings of the items. Moderate gains in information are obtained for low to slightly above average abilities. The dichotomous and polychotomous models are then compared for their relative performances in appropriateness measurement. The rates of detection of some types of aberrance responding were more than 100 percent higher for optimal polychotomous model index. Consequently the MFS polychotomous model provides opportunities for better testing by allowing more accurate ability estimates, improvements in the theory and practice of item writing, and more powerful appropriateness measurement. GRA

**N88-19091#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**FIRST ENCOUNTERS OF THE CLOSE KIND: THE FORMATION PROCESS OF AIRLINE FLIGHT CREWS Ph.D. Thesis**
Robert C. Ginnett 1987 275 p
(AD-A187977; AFIT/CI/NR-87-138D) Avail: NTIS HC A12/MF A01 CSCL 05H

Members of airline cockpit crews often have never worked together or even met prior to their scheduled flight. Crewmembers report that they can determine how effective a given captain will be as a crew leader in the first few minutes of the crew's life. This research examined six captains who were effective crew leaders and four who were less than effective. Data were collected both during the time of crew information and during line operations. The effective captains created multiple conditions for team effectiveness from the moment their crews first met. In initial briefings, for example, they affirmed the boundary of the group, discussed aspects of the work that required coordination (both within the crew, and with others), and fostered norms that encouraged teamwork. They also lessened crewmembers' traditional dependence on the captain by actively engaging members in their briefings. Although each used different tactics, the team effectiveness strategies used in the briefings remained consistent throughout the life of their crews. The less effective captains did not exhibit consistent team leadership strategies. Instead, each exercised control in ways that interfered with team effectiveness. GRA

**N88-19092#** Colorado Univ., Boulder. Center for Research on Judgment and Policy.
**EFFECTS OF STRESS ON JUDGEMENT AND DECISION MAKING IN DYNAMIC TASKS Interim Report, Sep. 1986 - Aug. 1987**
Kenneth R. Hammond Oct. 1987 8 p
(Contract MDA903-86-C-0142; DA Proj. 2Q1-61102-B-74-F)
(AD-A188203; ARI-RN-87-43) Avail: NTIS HC A02/MF A01 CSCL 05H

Expert weather forecasters were observed as they attempted to forecast hail, microbursts, and severe storms. Studies of judgement policies were also conducted with representations of storms. Modest agreement among forecasters was found in all three cases, but hail forecasts were found to be of low accuracy. Judgement models, an AI expert system, and seven forecasters showed about the same degree of accuracy. Current psychological theory concerning judgement and decision making was found to be sufficient for these circumstances. GRA

**N88-19093#** Purdue Univ., West Lafayette, Ind. EEG Signal Processing Lab.
**ELECTROMAGNETIC METRICS OF MENTAL WORKLOAD Final Report, 15 Aug. 1985 - 14 Aug. 1986**
J. I. Aunon, B. H. Kantowitz, C. D. McGillem, and M. P. Plonski Sep. 1987 223 p
(Grant AF-AFOSR-0313-85)
(AD-A188205; AFOSR-87-1663TR) Avail: NTIS HC A10/MF A01 CSCL 05H

Mental workload has been very difficult to describe quantitatively. An excessive workload can lead to an decrease in accuracy and performance, while a sustained high level of workload can lead to mental exhaustion. Previous research has indicated that heart rate variability and evoked potentials in the EEG (electroencephalogram) may be linked to mental workload. Unfortunately most of the work to date has examined these two biocybernetic variables independently rather than jointly. Recent advances now allow one to measure the magnetic fields produced by the brain (MEG) using a SQUID magnetometer (Superconducting Quantum Interference Devices). Much of the MEG research to date has concentrated on lower order brain processes rather than the higher cognitive processes associated with workload. The current research examines all these biocybernetic variables jointly in an effort to quantify mental workload. A paradigm was developed to vary several aspects of mental workload and verify the hybrid capacity model of human information processing that was developed at Purdue. This research included constructing a data acquisition system to implement this paradigm and simultaneously record heart rate, respiration, EEG and MEG data. It is believed that this is the first time that such a varied data set was recorded simultaneously. GRA

**N88-19094*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SPACE VEHICLE APPROACH VELOCITY JUDGMENTS UNDER SIMULATED VISUAL SPACE CONDITIONS**
Richard F. Haines Aug. 1987 13 p
(NASA-TM-89437; A-87136; NAS 1.15:89437) Avail: NTIS HC A03/MF A01 CSCL 05I

Thirty-five volunteers responded when they first perceived an increase in apparent size of a collimated, 2-D image of an Orbiter vehicle. The test variables of interest included the presence of a fixed angular reticle within the field of view (FOV); three initial Orbiter distances; three constant Orbiter approach velocities corresponding to 1.6, 0.8, and 0.4 percent of the initial distance per second; and two background starfield velocities. It was found that: (1) at each initial range, increasing approach velocity led to a larger distance between the eye and Orbiter image at threshold; (2) including the fixed reticle in the FOV produced a smaller distance between the eye and Orbiter image at threshold; and (3) increasing background star velocity during this judgment led to a smaller distance between the eye and Orbiter image at threshold. The last two findings suggest that other detail within the FOV may compete for available attention which otherwise would be available for judging image expansion; thus, the target has to approach the observer nearer than otherwise if these details were present. These findings are discussed in relation to previous research and possible underlying mechanisms. Author

# 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

**N88-19095#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**WHEN DECISION AIDS FAIL Final Report, 15 Jun. 1985 - 15 Jun. 1986**
Erhard O. Eimer Mar. 1987 33 p
(AD-A187531; AAMRL-TR-87-035) Avail: NTIS HC A03/MF A01 CSCL 23B

This research was concerned with ways in which a C3-system adapts to the breakdown of a decision aiding device (DAD). Subjects were tested in a team judgement task in which they had to predict the outcome of an uncertain, dynamic event on discrete trails, with or without the use of a DAD of varying validity. After

training, DAD validity was reduced to zero. Subjects performed more poorly with a DAD of low validity than without a DAD. Subjects consistently performed more poorly than they could have by using a maximizing strategy. After DAD breakdown, subjects performed more poorly than control subjects who never used a DAD. Prior DAD validity had no effect on performance with an invalid DAD. Performance with an invalid DAD was found to be predicted by efficiency, the ability to use valid and ignore invalid information. GRA

**N88-19096#** Naval Submarine Medical Research Lab., Groton, Conn.
**BRIGHTNESS CONTRAST AND CHARACTER HEIGHT OF FIVE FLAT PANEL COMPUTER DISPLAYS Memorandum Report**
Kevin Laxar, David F. Neri, and Saul M. Luria 2 Sep. 1987 11 p
(AD-A187743; NSMRL-MR-87-5) Avail: NTIS HC A03/MF A01 CSCL 12F

To determine the relative legibility of the flat panel displays of five IBM-PC compatible lap-top microcomputers, their brightness contrasts and character heights, which generally contribute to legibility, were measured under normal lighting and in the dark. The Datavue 25, the Toshiba T1100 Plus, and the Zenith Z-181 used a liquid crystal display in various foreground/background color combinations. The Data General (DG) One had an electroluminescent display, and the Grid-Gridcase 3 used a plasma display, both of which are self-luminous. The brightness contrast of all the displays was acceptable under normal lighted conditions. The DG One had the highest contrast in a lighted room (92 percent), at viewing angles both normal to the vertical screen surface and at 45 in the horizontal plane. The DG One and the Gridcase 3 had the highest contrast in the dark (over 98 percent). The Toshiba's screen was not backlighted and could not be used in a dark room. All the screens displayed 25 lines of 80 characters. The height of upper case characters ranged from 0.137 to 0.208 inches, and all were acceptable for normal viewing distances. normal viewing distances. Keywords: Laptop computers; Microcomputers; Display systems; Liquid crystal display systems; Photometry; Screens (Display); Image processing. GRA

**N88-19097#** Aeronautical Research Labs., Melbourne (Australia).
**A WORKED EXAMPLE OF AN APPLICATION OF THE SAINT SIMULATION PROGRAM**
S. Sestito Sep. 1987 33 p
(AD-A188198; ARL-SYS-TM-93; DODA-AR-004-554) Avail: NTIS HC A03/MF A01 CSCL 12E

The Systems Analysis of Integrated Networks of Tasks (SAINT) is a network modeling and simulation technique developed to assist the design and analysis of complex human-machine systems. Thus document discusses some of the SAINT concepts, the development of a SAINT network, the method of inputting the network into the SAINT environment, and presents a brief look at the output from SAINT. GRA

**N88-19098#** Pacific Northwest Labs., Richland, Wash.
**AN ECONOMIC ANALYSIS OF A MULTI-COMMODITY FRUIT AND VEGETABLE IRRADIATOR**
M. D. Brown, D. E. Eakin, J. K. Young, and G. L. Tingey Jul. 1987 26 p Presented at the American Institute of Chemical Engineers Summer National Meeting, Minneapolis, Minn., 6 Aug. 1987
(Contract DE-AC06-76RL-01830)
(DE88-003425; PNL-SA-15112; CONF-870822-8) Avail: NTIS HC A03/MF A01

Although irradiation of foods has been studied since the late 1940's and irradiation of grains and potatoes has been approved for years, only recently has the Food and Drug Administration approved irradiation of pork, fresh fruits and vegetables at doses up to 100 krad for commercial sale. A key element in commercializing irradiation technology by the food processing industry is economic viability. This paper presents an economic analysis for a multi-commodity fruit and vegetable irradiator processing apples, cherries, pears, asparagus, onions, and potatoes. Dose, throughput, and the schedule were examined. Design information and capital and operating costs for various sizes of irradiators are presented. The economics look promising, with typical costs in larger facilities in the range of a few cents per pound of product. DOE

# 55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

# 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

**N88-19099*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**CUMULATIVE REPORTS AND PUBLICATIONS THROUGH DECEMBER 31, 1987 Final Report**
Feb. 1988 58 p
(Contracts NAS1-18107; NAS1-17070; NAS1-17130; NAS1-15810; NAS1-16394; NAS1-14101; NAS1-14472)
(NASA-CR-181624; NAS 1.26:181624) Avail: NTIS HC A04/MF A01 CSCL 12A

This document contains a complete list of Institute for Computer Applications in Science and Engineering (ICASE) Reports. Since ICASE Reports are preprints of articles to be published in journals or conference proceeding, the published reference is included when available. Author

**N88-19100*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**IDEAL SHRINKING AND EXPANSION OF DISCRETE SEQUENCES**
Andrew B. Watson Jan. 1986 36 p
(NASA-TM-88202; A-86070; NAS 1.15:88202) Avail: NTIS HC A03/MF A01 CSCL 12A

Ideal methods are described for shrinking or expanding a discrete sequence, image, or image sequence. The methods are ideal in the sense that they preserve the frequency spectrum of the input up to the Nyquist limit of the input or output, whichever is smaller. Fast implementations that make use of the discrete Fourier transform or the discrete Hartley transform are described. The techniques lead to a new multiresolution image pyramid. Author

**N88-19101*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**PARALLEL PSEUDOSPECTRAL DOMAIN DECOMPOSITION TECHNIQUES Final Report**
David Gottlieb and Richard S. Hirsh (Johns Hopkins Univ., Laurel, Md.) Feb. 1988 29 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181629; ICASE-88-15; NAS 1.26:181629) Avail: NTIS HC A03/MF A01 CSCL 12A

The influence of interface boundary conditions on the ability to parallelize pseudospectral multidomain algorithms is investigated. Using the properties of spectral expansions, a novel parallel two domain procedure is generalized to an arbitrary number of domains each of which can be solved on a separate processor. This interface boundary condition considerably simplifies influence matrix techniques. Author

**N88-19102*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**APPLICATION OF ADVANCED COMPUTATIONAL TECHNOLOGY TO PROPULSION CFD**
John R. Szuch 1988 21 p Proposed for presentation at the Symposium on Advances and Trends in Computational Structural Mechanics and Fluid Dynamics, Washington, D.C., 17-19 Oct. 1988
(NASA-TM-100843; E-4034; NAS 1.15:100843) Avail: NTIS HC A03/MF A01 CSCL 12A

The Internal Fluid Mechanics Division of the NASA Lewis Research Center is combining the key elements of computational fluid dynamics, aerothermodynamic experiments, and advanced computational technology to bring internal computational fluid dynamics (ICFM) to a state of practical application for aerospace propulsion system design. This paper presents an overview of efforts under way at NASA Lewis to advance and apply computational technology to ICFM. These efforts include the use of modern, software engineering principles for code development, the development of an AI-based user-interface for large codes, the establishment of a high-performance, data communications network to link ICFM researchers and facilities, and the application of parallel processing to speed up computationally intensive and/or time-critical ICFM problems. A multistage compressor flow physics program is cited as an example of efforts to use advanced computational technology to enhance a current NASA Lewis ICFM research program. Author

# 60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

**N88-19103#** Honeywell, Inc., Bloomington, Minn. Physical Sciences Center.
**OPTICAL SYMBOLIC PROCESSOR FOR EXPERT SYSTEM EXECUTION Quarterly Status Report No. 5, 1 Jun. - 31 Aug. 1987**
Aloke Guha 31 Aug. 1987 5 p
(Contract F49620-86-C-0082; ARPA Order 5794)
(AD-A187882; AFOSR-87-1644TR) Avail: NTIS HC A02/MF A01 CSCL 12F

In this quarter, we conducted a performance evaluation of the proposed optical architecture SPARO (Symbolic Processing Architecture in Optics). Specifically, we examined the performance of the ring interconnection network of SPARO. An accurate performance model was developed for predicting the message throughout of bidirectional ring network. As suspected earlier, the ring network was the bottleneck in the performance. This led us to study other network topologies that are both feasible in optics and yield high throughput. The final choice of the optical interconnection network topology was deemed by the replicated perfect shuffle network. GRA

**N88-19104#** Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
**MEASUREMENT AND ANALYSIS OF MEMORY CONFLICTS ON VECTOR MULTIPROCESSORS Interim Report**
D. A. Calahan and D. H. Bailey 1 Oct. 1987 36 p
(Grant AF-AFOSR-0096-84)
(AD-A188206; AFOSR-87-1601TR) Avail: NTIS HC A03/MF A01 CSCL 12F

The memory organization and technological design parameters which create memory access conflicts and affect performance of the CRAY family of processors are studied. Measurements on the dynamic-memory CRAY-2 system are presented. GRA

**N88-19105#** Army Engineer Topographic Labs., Fort Belvoir, Va.
**DIGITAL DATA DUBBING CAPABILITY**
William B. Brierly, Jr. 13 Oct. 1987 8 p
(AD-A188252; ETL-R119) Avail: NTIS HC A02/MF A01 CSCL 08G

Digital data are the key ingredients to the operation of any computer system. It is analogous to the fuel which powers a car. Computers, like cars, can be designed and built to perform amazing feats - but if you can't feed the monster, it will die. The U.S. Army currently has over 70 systems or programs planned, under development or fielded that require digital topographic/terrain data (DTD) for their operation. Often these systems cannot share data already being produced and in existence, i.e., they have their own unique data specification. The Defense Mapping Agency (DMA) has been the principal producer of DTD for the armed services but has stated repeatedly in recent years that they do not have enough resources to support a proliferation of systems each with its own unique data specification. DMA therefore has opted to issue a standard products list of 28 products (at this time) - 16 of which are digital data MC and G products describing terrain and feature information. GRA

**N88-19106#** Ceskoslovenska Akademie Ved, Prague.
**MODULAR CAMAC SYSTEM, 2**
B. Hajek, ed. Sep. 1986 99 p In CZECH
(DE88-700237; INIS-mf-11031) Avail: NTIS (US Sales Only) HC A05/MF A01

The application is described of the modular CAMAC system in technical practice and its use in nuclear instrumentation. The set of instruments of the NL 2000 series is designed for measurement and control in laboratories and in industries. The basic data and properties of the NL system are given and a list presented of units developed. The general characteristics are given of the MULTIBUS 2 system which features flexibility and versatility in a wide range of applications. The full texts are given of CMEA standards 4919-84: CAMAC System - Several controllers in the rack. DOE

**N88-19107#** Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
**VAXELN EXPERIMENTATION: PROGRAMMING A REAL-TIME CLOCK AND INTERRUPT HANDLING USING VAXELN Ada 1.1 Final Technical Report**
Mark W. Borger Oct. 1987 59 p Sponsored by DOD, Washington, D.C.
(AD-A188100; CMU/SEI-87-TR-29; ESD-TR-87-188) Avail: NTIS HC A04/MF A01 CSCL 12F

This report describes the results of implementing an interrupt handler totally in Ada for a MicroVas 2/VAXELN 2.3 target system, the VAXELN 1.1 Ada compiler, and a KWV11-C programmable real-time clock. It provides an overview of VAXELN interrupt handlers and the operation of the real-time clock; discusses and demonstrates the use of VAXELN kernel services to establish a link between the clock's interrupt and the starting address an interrupt service routine; presents an Ada package of interfaces to the KWV11-C device; provides Ada source code examples demonstrating the use of this package; and presents relevant observations, recommendations, and measurement results. GRA

**N88-19108#** Allied Bendix Aerospace, Kansas City, Mo.
**APPLICATIONS OF LOWER COST COMPUTERS TO DIMENSIONAL GAGING**
R. E. Hines Feb. 1987 30 p
(Contract DE-AC04-76DP-00613)
(BDX-613-3606) Avail: NTIS HC A03/MF A01

Small, lower cost microcomputers have been used in two computer-assisted gaging applications. Both provide capabilities that would be difficult and time-consuming to obtain by manual methods. A calculator and eight LVDT gage heads measure the thickness of a part at 64 evenly spaced locations. The computer applies complex secondary tolerances that have permitted the product yield to increase to 95 percent from the previous 50

percent. A microcomputer uses two LVDT gage heads to measure the inside and outside diameters and roundness of other parts. Measurements are taken automatically at 16 equally spaced locations as the product rotates past the probes. Author

**N88-19109#** Council for Mineral Technology, Randburg (South Africa).
**INTERFACING OF A MICROCOMPUTER WITH A SIMULTANEOUS ATOMIC-EMISSION SPECTROMETER**
G. L. Moore, R. L. Paul, and D. R. Groot 17 Aug. 1987 13 p (PB88-139571; MINTEK-M322; ISBN-0-86999-812-9) Avail: NTIS HC A03/MF A01 CSCL 09B

Two Hilger Analytical E1000 simultaneous atomic emission spectrometers were successfully interfaced to Apple IIe microcomputers. Each microcomputer starts the spectrometer, controls the potentials applied to the photomultiplier tubes, and processes the intensity data. The software, which was written in assembler language and BASIC, allows for 36 analytical methods, each containing up to 30 analyses and using from 3 to 6 calibration standards. Internal standardization is an option on all channels. Intensity data for 396 integrations for all channels are stored on magnetic disc, and can be recalled for use in the analytical program. Calibration graphs can be viewed on the monitor display or printed out. Author

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

**N88-19110#** AMAX Research and Development Center, Golden, Colo.
**MATHEMATICAL MODELING OF TWO-STATE CLASSIFICATION TECHNOLOGY TRANSFER SUMMARY AND USER'S GUIDE**
L. K. Baltich Aug. 1987 118 p
(Contract DE-FC07-83ID-12440)
(DE88-003849; DOE/ID-12440/3) Avail: NTIS HC A06/MF A01

CIRCUIT is a computer program developed for use in designing optimum two-stage classification configurations and operating conditions for energy conservation. It was developed in a cooperative effort between AMAX Research and Development Center and the US Department of Energy, Conservation Technologies Division. This document contains the final summary report for the technology phase of the project and the User's Guide for CIRCUIT. CIRCUIT is now available for use with IBM compatible personal computers. DOE

**N88-19111*#** Rensselaer Polytechnic Inst., Troy, N.Y. Center for Interactive Computer Graphics/CAM-1.
**WORKSHOP ON THE INTEGRATION OF FINITE ELEMENT MODELING WITH GEOMETRIC MODELING**
Michael J. Wozny 12 May 1987 330 p Workshop held in Troy, N.Y., 12 May 1987
(Grant NAG5-487)
(NASA-CR-182515; NAS 1.26:182515) Avail: NTIS HC A15/MF A01 CSCL 09B

The workshop on the Integration of Finite Element Modeling with Geometric Modeling was held on 12 May 1987. It was held to discuss the geometric modeling requirements of the finite element modeling process and to better understand the technical aspects of the integration of these two areas. The 11 papers are presented except for one for which only the abstract is given. For individual titles, see N88-19112 through N88-19125.

**N88-19112*#** Rensselaer Polytechnic Inst., Troy, N.Y. Center for Interactive Computer Graphics.
**INTEGRATION OF FINITE ELEMENT MODELING WITH SOLID MODELING THROUGH A DYNAMIC INTERFACE**
Mark S. Shephard *In its* Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 12 p (For primary document see N88-19111 11-61)
Avail: NTIS HC A15/MF A01 CSCL 09B

Finite element modeling is dominated by geometric modeling type operations. Therefore, an effective interface to geometric modeling requires access to both the model and the modeling functionality used to create it. The use of a dynamic interface that addresses these needs through the use of boundary data structures and geometric operators is discussed. Author

**N88-19113*#** Rensselaer Polytechnic Inst., Troy, N.Y. Center for Interactive Computer Graphics.
**APPROACHES TO THE AUTOMATIC GENERATION AND CONTROL OF FINITE ELEMENT MESHES**
Mark S. Shephard *In its* Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 55 p (For primary document see N88-19111 11-61)
(Grants NSF MSM-83-05950; NSF DCM-86-03025)
Avail: NTIS HC A15/MF A01 CSCL 09B

The algorithmic approaches being taken to the development of finite element mesh generators capable of automatically discretizing general domains without the need for user intervention are discussed. It is demonstrated that because of the modeling demands placed on a automatic mesh generator, all the approaches taken to date produce unstructured meshes. Consideration is also given to both a priori and a posteriori mesh control devices for automatic mesh generators as well as their integration with geometric modeling and adaptive analysis procedures. Author

**N88-19114*#** Rensselaer Polytechnic Inst., Troy, N.Y.
**INTEGRATION OF GEOMETRIC MODELING AND ADVANCED FINITE ELEMENT PREPROCESSING**
Mark S. Shephard and Peter M. Finnigan (General Electric Co., Schenectady, N.Y.) *In its* Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 24 p (For primary document see N88-19111 11-61)
Avail: NTIS HC A15/MF A01 CSCL 09B

The structure to a geometry based finite element preprocessing system is presented. The key features of the system are the use of geometric operators to support all geometric calculations required for analysis model generation, and the use of a hierarchic boundary based data structure for the major data sets within the system. The approach presented can support the finite element modeling procedures used today as well as the fully automated procedures under development. Author

**N88-19115*#** Swanson Analysis Systems, Inc., Houston, Pa. General Development.
**FINITE ELEMENT MESHING OF ANSYS (TRADEMARK) SOLID MODELS**
F. S. Kelley *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 17 p (For primary document see N88-19111 11-61)
Avail: NTIS HC A15/MF A01 CSCL 09B

A large scale, general purpose finite element computer program, ANSYS, developed and marketed by Swanson Analysis Systems, Inc. is discussed. ANSYS was perhaps the first commercially available program to offer truly interactive finite element model generation. ANSYS's purpose is for solid modeling. This application is briefly discussed and illustrated. E.R.

**N88-19116*#** Sandia National Labs., Albuquerque, N. Mex. CAD Technology Div.
**SOLID/FEM INTEGRATION AT SNLA**
Patrick F. Chavez *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 16 p (For primary document see N88-19111 11-61)
(Contract DE-AC04-76DP-00789)
(SAND87-0882A) Avail: NTIS HC A15/MF A01 CSCL 09B

The effort at Sandia National Labs. on the methodologies and techniques being used to generate strict hexahedral finite element meshes from a solid model is described. The functionality of the modeler is used to decompose the solid into a set of nonintersecting meshable finite element primitives. The description of the decomposition is exported, via a Boundary Representative format, to the meshing program which uses the information for complete finite element model specification. Particular features of the program are discussed in some detail along with future plans for development which includes automation of the decomposition using artificial intelligence techniques. Author

**N88-19117*#** Rochester Univ., N. Y. Dept. of Mechanical Engineering.

**OCTREE BASED AUTOMATIC MESHING FROM CSG MODELS Abstract Only**

Renato Perucchio *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 1 p (For primary document see N88-19111 11-61)

Avail: NTIS HC A15/MF A01 CSCL 09B

Finite element meshes derived automatically from solid models through recursive spatial subdivision schemes (octrees) can be made to inherit the hierarchical structure and the spatial addressability intrinsic to the underlying grid. These two properties, together with the geometric regularity that can also be built into the mesh, make octree based meshes ideally suited for efficient analysis and self-adaptive remeshing and reanalysis. The element decomposition of the octal cells that intersect the boundary of the domain is emphasized. The problem, central to octree based meshing, is solved by combining template mapping and element extraction into a procedure that utilizes both constructive solid geometry and boundary respresentation techniques. Boundary cells that are not intersected by the edge of the domain boundary are easily mapped to predefined element topology. Cells containing edges (and vertices) are first transformed into a planar polyhedron and then triangulated via element extractors. The modeling environments required for the derivation of planar polyhedra and for element extraction are analyzed. Author

**N88-19118*#** Rochester Univ., N. Y. Production Automation Project.

**GEOMETRICAL AND TOPOLOGICAL ISSUES IN OCTREE BASED AUTOMATIC MESHING**

Mukul Saxena and Renato Perucchio *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 15 p Presented at the NAFEMS International Conference on Quality Assurance and Standards in Finite Element Analysis, Brighton, United Kingdom, 13-15 May 1987 (For primary document see N88-19111 11-61)

Avail: NTIS HC A15/MF A01 CSCL 09B

Finite element meshes derived automatically from solid models through recursive spatial subdivision schemes (octrees) can be made to inherit the hierarchical structure and the spatial addressability intrinsic to the underlying grid. These two properties, together with the geometric regularity that can also be built into the mesh, make octree based meshes ideally suited for efficient analysis and self-adaptive remeshing and reanalysis. The element decomposition of the octal cells that intersect the boundary of the domain is discussed. The problem, central to octree based meshing, is solved by combining template mapping and element extraction into a procedure that utilizes both constructive solid geometry and boundary representation techniques. Boundary cells that are not intersected by the edge of the domain boundary are easily mapped to predefined element topology. Cells containing edges (and vertices) are first transformed into a planar polyhedron and then triangulated via element extractor. The modeling environments required for the derivation of planar polyhedra and for element extraction are analyzed. Author

**N88-19119*#** General Electric Co., Schenectady, N.Y. Corporate Research and Development.

**A HIERARCHICAL STRUCTURE FOR AUTOMATIC MESHING AND ADAPTIVE FEM ANALYSIS**

Ajay Kela, Mukul Saxena, and Renato Perucchio (Rochester Univ., N. Y.) *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 34 p Submitted for publication (For primary document see N88-19111 11-61)

(Grants NSF ECS-81-04646; NSF DMC-84-03882)

Avail: NTIS HC A15/MF A01 CSCL 09B

A new algorithm for generating automatically, from solid models of mechanical parts, finite element meshes that are organized as spatially addressable quaternary trees (for 2-D work) or octal trees (for 3-D work) is discussed. Because such meshes are inherently hierarchical as well as spatially addressable, they permit efficient substructuring techniques to be used for both global analysis and incremental remeshing and reanalysis. The global and incremental techniques are summarized and some results from an experimental closed loop 2-D system in which meshing, analysis, error evaluation, and remeshing and reanalysis are done automatically and adaptively are presented. The implementation of 3-D work is briefly discussed. Author

**N88-19120*#** Rochester Univ., N. Y. Production Automation Project.

**TOWARD AUTOMATIC FINITE ELEMENT ANALYSIS**

Ajay Kela, Renato Perucchio, and Herbert Voelcker (Cornell Univ., Ithaca, N.Y.) *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 15 p (For primary document see N88-19111 11-61)

(Grants NSF ECS-84-04646; NSF DMC-84-03882)

Avail: NTIS HC A15/MF A01 CSCL 09B

Two problems must be solved if the finite element method is to become a reliable and affordable blackbox engineering tool. Finite element meshes must be generated automatically from computer aided design databases and mesh analysis must be made self-adaptive. The experimental system described solves both problems in 2-D through spatial and analytical substructuring techniques that are now being extended into 3-D. Author

**N88-19121*#** Rensselaer Polytechnic Inst., Troy, N.Y. Center for Interactive Computer Graphics.

**FINITE OCTREE MESHING THROUGH TOPOLOGICALLY DRIVEN GEOMETRIC OPERATORS**

Kurt R. Grice *In its* Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 26 p (For primary document see N88-19111 11-61)

Avail: NTIS HC A15/MF A01 CSCL 09B

The octree technique is developed into the finite octree, and an overview is given. Modeler requirements are given. The octree discretization is discussed along with geometric communication operators. Geometric communication operators returning topological associativity and geometric communication operators returning spatial data are also discussed and illustrated. The advantages are given of the boundary representation and of geometric communication operators. The implementation plays an important role in the integration with a variety of geometric modelers. The capabilities of closed loop processes within a complete finite element system are presented. E.R.

**N88-19122*#** General Motors Corp., Warren, Mich. Engineering Mechanics Dept.

**DESIGN MODELING FOR SHAPE OPTIMIZATION**

M. E. Botkin *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 6 p (For primary document see N88-19111 11-61)

Avail: NTIS HC A15/MF A01 CSCL 09B

Some important aspects of design modeling for shape optimization are discussed for both stamped sheet metal components and cast solid components. For stamped components

the basis for the modeling approach is a boundary design function. Design parameters control the shape of 2-D regions. For more complex, folded plate components, the 2-D regions can be assembled using translation and rotation operations. The analysis model is automatically created using a mesh generation procedure requiring only boundary data. For less complex solid components, it was found that this approach is not suitable. For these structures, the finite element models are typically created using very sophisticated graphical modeling systems. A new approach which overlays a parameterized surface design model on an existing analysis model is described. To summarize, the future needs for solid shape design is described in terms of an extension of the previously described 2-D capability. Author

**N88-19123*#** General Motors Corp., Warren, Mich. Engineering Mechanics Dept.
**SHAPE OPTIMIZATION OF THREE-DIMENSIONAL STAMPED AND SOLID AUTOMOTIVE COMPONENTS**
M. E. Botkin, R.-J. Yang, and J. A. Bennett *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 39 p Submitted for publication (For primary document see N88-19111 11-61)
(GMR-5168) Avail: NTIS HC A15/MF A01 CSCL 09B

The shape optimization of realistic, 3-D automotive components is discussed. The integration of the major parts of the total process: modeling, mesh generation, finite element and sensitivity analysis, and optimization are stressed. Stamped components and solid components are treated separately. For stamped parts a highly automated capability was developed. The problem description is based upon a parameterized boundary design element concept for the definition of the geometry. Automatic triangulation and adaptive mesh refinement are used to provide an automated analysis capability which requires only boundary data and takes into account sensitivity of the solution accuracy to boundary shape. For solid components a general extension of the 2-D boundary design element concept has not been achieved. In this case, the parameterized surface shape is provided using a generic modeling concept based upon isoparametric mapping patches which also serves as the mesh generator. Emphasis is placed upon the coupling of optimization with a commercially available finite element program. To do this it is necessary to modularize the program architecture and obtain shape design sensitivities using the material derivative approach so that only boundary solution data is needed. Author

**N88-19124*#** Hibbitt, Karlsson and Sorensen, Providence, R.I.
**POSTPROCESSING TECHNIQUES FOR 3D NON-LINEAR STRUCTURES**
Richard S. Gallagher *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 8 p (For primary document see N88-19111 11-61)
Avail: NTIS HC A15/MF A01 CSCL 09B

How graphics postprocessing techniques are currently used to examine the results of 3-D nonlinear analyses, some new techniques which take advantage of recent technology, and how these results relate to both the finite element model and its geometric parent are reviewed. Author

**N88-19125*#** Northrop Corp., Hawthorne, Calif.
**GEOMETRIC VERSUS FINITE ELEMENT MODELING CURRENT AND FUTURE TRENDS AT NORTHROP**
Shiv K. Bajaj *In* Rensselaer Polytechnic Inst., Workshop on the Integration of Finite Element Modeling with Geometric Modeling 12 May 1987 32 p (For primary document see N88-19111 11-61)
Avail: NTIS HC A15/MF A01 CSCL 09B

Engineering Automation at Northrop encompasses the various design and analytical phases of air vehicle development. Design systems addresses automation of engineering/tooling design and computer aided manufacturing processes. The analysis systems automate aeroelastic modeling and postprocessing analysis results. These systems interface with aircraft loft and geometric entities thru localized transfer techniques. However, total integration effort based on a geometric database nucleus with peripheral design, analytical and manufacturing systems is well underway. An outline of the present and future trends is presented to help channel the RPI effort in this direction. Author

**N88-19126#** Scripps Clinic and Research Foundation, La Jolla, Calif.
**THREE-DIMENSIONAL COMPUTER GRAPHICS BRAIN-MAPPING PROJECT Annual Report, 10 Mar. 1986 - 9 Mar. 1987**
Robert B. Livingston 15 Mar. 1987 86 p
(Contract DAMD17-86-C-6093)
(AD-A187202) Avail: NTIS HC A05/MF A01 CSCL 06D

The Brain Mapping Project has established and tested innovative techniques for quantitative mapping of human and animal neuroanatomy and has demonstrated the feasibility of computer graphics approaches. The emerging technology aims to acquire computer-generated tissue section maps in microscopic detail, in registration, and to reconstruct such images accurately in three dimensions. The completed system will provide a valuable tool for investigating clinical and basic neurological problems and for establishing three dimensional database standards for comparing processes of normal and abnormal growth, development, degeneration, injury and disease processes. This approach will enable confident mapping of correlations between structures and functions, and it will foster improved understanding of brain organization as an integrated whole. GRA

**N88-19127#** Arizona State Univ., Tempe. Semiconductor Materials Research Lab.
**DIGITAL CONTROL OF THE CZOCHRALSKI GROWTH OF GALLIUM ARSENIDE-CONTROLLER SOFTWARE REFERENCE MANUAL Final Scientific Report, 1 Oct. 1985 - 31 Mar. 1987**
Karl Riedling and G. H. Schwuttke 15 Jul. 1987 197 p
(Contract F49620-85-C-0010; ARPA Order 5187)
(AD-A187210; AFOSR-87-1542TR) Avail: NTIS HC A09/MF A01 CSCL 12E

This volume provides a complete description of the structure and the operation of the specific controller software developed for ASU's digital Czochralski Growth Control System (CGCS) for compound semiconductors. The manual is primarily intended for use by advanced programmers and crystal growth specialists. In four main chapters, the Controller Software Reference Manual discusses the design considerations applied to digital LEC crystal growth control, give a short overview over the growth controller computer hardware and operating system environment, describes the functions of the CGCS from an operator's point of view, and delineates the internal operations of the controller software by discussing the controller software and algorithms. Various appendices provide tables of controller software tasks, routines, and variables, file format information, and lists of system messages and error codes. GRA

**N88-19128#** Advanced Systems Development, Inc., Arlington, Va.
**REPORT ON DESKTOP PUBLISHING**
Jul. 1987 47 p Prepared in cooperation with Applied Technologies, Washington, D.C.
(Contract MDA903-85-C-0340)
(AD-A187698) Avail: NTIS HC A03/MF A01 CSCL 12E

This market survey of microcomputer-based desktop publishing systems, both hardware and software, is intended to provide a basis for making a decision on the advisability of conducting benchmark studies of selected systems, matched against functional requirements specifications. All of the narrative material is introductory in nature, providing only highlights on the nature of desktop publishing, and pointing to elemental observations about the characteristics of the various components. The heart of the study is contained in the appended charts, which identify how completely each component has implemented its function. Research of the current market place for desktop publishing

systems was conducted in the following manner: (1) Information was requested of all known vendors of Desktop Publishing software and hardware; (2) Technical journals, books and magazines were researched for reviews and articles on desktop publishing systems. GRA

**N88-19129#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
**KR: AN EFFICIENT KNOWLEDGE REPRESENTATION SYSTEM Interim Report**
Dario Giuse Oct. 1987 26 p
(Contract F33615-84-K-1520; DARPA Order 4976)
(AD-A187705; CMU-RI-TR-87-23) Avail: NTIS HC A03/MF A01 CSCL 12E

KR is a very efficient semantic network knowledge representation language implemented in Common Lisp. It provides basic mechanisms for knowledge representation which include user-defined inheritance, relations, and the usual repertoire of knowledge manipulation functions. The system is simple and compact and does not include some of the more complex functionality often found in other knowledge representation systems. Because of its simplicity, however, KR is highly optimized and offers good performance. These qualities make it suitable for many applications which require a mixture of good performance and flexible knowledge representation. GRA

**N88-19130#** Utah Univ., Salt Lake City. Dept. of Computer Science.
**EFFICIENT INSTRUCTION LEVEL SIMULATION OF COMPUTERS**
Richard M. Fujimoto and William B. Campbell 1987 27 p
(Contract N00014-87-K-0184)
(AD-A187821; UUCS-87-022) Avail: NTIS HC A03/MF A01 CSCL 12E

A technique for creating efficient, yet highly accurate, instruction level simulation models of computers is described. In contrast to traditional approaches that use a software interpreter this technique employs direct execution of application programs on the host computer. An assembly language program for the machine to be modeled is decompiled to a high level language, instrumented, and then recompiled and executed on the host computer. A prototype implementation modeling the Motorola MC68010 microprocessor is described, and the efficiency and accuracy of this prototype is reported. It is demonstrated that the direct execution technique can be used to produce accurate simulation models which are orders of magnitude faster than traditional, register level simulators. GRA

**N88-19131#** Utah Univ., Salt Lake City. Dept. of Computer Science.
**OPTIMAL PERFORMANCE OF DISTRIBUTED SIMULATION PROGRAMS**
Steven M. Swope and Richard M. Fujimoto 1987 16 p
(Contract N00014-87-K-0184)
(AD-A187822; UUCS-87-023) Avail: NTIS HC A03/MF A01 CSCL 12E

This paper describes a technique to analyze the potential speedup of distributed simulation programs. A distributed simulation strategy is proposed which minimizes execution time through the use of an oracle to control the simulation. Because the strategy relies on an oracle, it cannot be used for practical simulations. However, the strategy facilitates performance evaluations of distributed simulation strategies by providing a useful point of comparison and can be used to determine the suitability of specific applications for implementation on a parallel computer. Based on the proposed strategy, a tool has been developed to determine the maximum performance which can be achieved from a distributed simulation program. In this paper we describe the technique and its use in evaluating the parallelism available in distributed simulators of parallel computer systems. GRA

**N88-19132#** Utah Univ., Salt Lake City. Dept. of Computer Science.
**THE ROLL BACK CHIP: HARDWARE SUPPORT FOR DISTRIBUTED SIMULATION USING TIME WARP**
Richard M. Fujimoto, Jya-Jang Tsai, and Ganesh Gopalakrishnan Oct. 1987 29 p
(Contract N00014-87-K-0184; Grant NSF MIP-87-10874)
(AD-A187823; UUCS-87-025) Avail: NTIS HC A03/MF A01 CSCL 12E

Distributed simulation offers an attractive means of meeting the high computational demands of discrete event simulation programs. The Time Warp mechanism has been proposed to ensure correct sequencing of events in distributed simulation programs without blocking processes unnecessarily. However, the overhead of state saving and rollback in Time Warp is one obstacle that may severely degrade performance. A special purpose hardware component, the rollback chip (RBC), is proposed to manage the state of a processor and provide an efficient rollback mechanism within a node of a parallel computer. The chip may be viewed as a special purpose memory management unit that lies on the data path between processor and memory. The algorithm implemented by the rollback chip is described, as well as extensions to the basic design. Implementation of the chip is briefly discussed. In addition to distributed simulation, the rollback chip may be used in other applications using the Time Warp mechanism, notably distributed database concurrency control. GRA

**N88-19133#** Utah Univ., Salt Lake City. Dept. of Computer Science.
**PERFORMANCE MEASUREMENTS OF DISTRIBUTED SIMULATION STRATEGIES**
Richard M. Fujimoto 1987 29 p
(Contract N00014-87-K-0184; Grant NSF DCR-85-04826)
(AD-A187824; UUCS-87-026) Avail: NTIS HC A03/MF A01 CSCL 12E

Although many distributed simulation strategies have been developed, to date, little empirical data is available to evaluate their performance. A multiprocessor-based, distributed simulation testbed is described that was designed to facilitate controlled experimentation with distributed simulation algorithms. Using this testbed, the performance of simulation strategies using deadlock avoidance and deadlock detection and recovery techniques was examined under various synthetic workloads. The distributed simulators were compared with a uniprocessor-based event list implementation. Results of a series of experiments are reported that demonstrate that message population and the degree to which processes can look ahead in simulated time play critical roles in the performance of distributed simulators using these algorithms. An avalanche phenomenon was observed in the deadlock detection and recovery simulators as message population was increased, and was found to be a necessary condition for achieving good performance. It is demonstrated that these distributed simulation algorithms can provide significant speedups over sequential event list implementations for some workloads, even in the presence of only a moderate amount of parallelism and many feedback loops. However, a moderate to high degree of parallelism was not sufficient to guarantee good performance for all workloads that were tested. GRA

**N88-19134#** Sonex Enterprises, Inc., Fairfax, Va.
**FEASIBILITY STUDY OF GENERATING PLANS AND STRATEGIES FOR SOFTWARE TESTING BY KNOWLEDGE BASED SYSTEM Final Report**
Donald J. Matchinski 13 Oct. 1987 101 p
(Contract DAAB07-87-C-F012)
(AD-A187834) Avail: NTIS HC A06/MF A01 CSCL 12E

This report documents a software testing architecture that encompasses the entire automated system life cycle. The architecture is designed with a knowledge based component that uses captured expert testing experience. The output of the system is a software test plan in accordance with DOD-STD-2167. GRA

**N88-19135#** Naval Postgraduate School, Monterey, Calif.
**THE DESIGN AND IMPLEMENTATION OF PEDAGOGICAL SOFTWARE FOR THE MULTI-BACKEND/MULTI-LINGUAL DATABASE SYSTEM M.S. Thesis**
Craig W. Little Dec. 1987 123 p
(AD-A188106) Avail: NTIS HC A06/MF A01 CSCL 12E

Traditionally, courses in database systems do not use pedagogical software for the purpose of instructing the database systems, despite the progress made in modern database architecture. This thesis presents a working document to assist in the instruction of a new database system, the Multi-Backend Database System (MBDS) and the Multi-Lingual Database System (MLDS). As the course of instruction describes the creation and manipulation of each language, this pedagogical aid will demonstrate, utilizing the live database system, the procedures and methods learned in class. GRA

**N88-19136#** Futures Group, Glastonbury, Conn.
**STATE OF THE ART OF NATURAL LANGUAGE PROCESSING Study Report, 8 Jul.-15 Nov. 1987**
Thomas Anderson 15 Nov. 1987 42 p
(Contract DAAH01-87-C-0750; ARPA Order-5916)
(AD-A188112) Avail: NTIS HC A03/MF A01 CSCL 05G

A study was carried out to determine the state of the art of the natural language processing requirements of a battle management system. The study was based on a method developed by this contractor. Study results indicate the field is in an early stage of development and further progress will be required to achieve the tools for a natural language interface to a battle management system. GRA

**N88-19137#** North Carolina Univ., Chapel Hill. Dept. of Computer Science.
**EqL: THE LANGUAGE AND ITS IMPLEMANTATION**
Bharat Jayaraman and Gopal Gupta 1986 35 p
(Contract N00014-86-K-0680; Grant NSF DCF-86-03609)
(AD-A188161) Avail: NTIS HC A03/MF A01 CSCL 12E

EqL is a general-purpose language that combines the capabilities of functional and logic programming languages. A program in EqL consists of a collection of conditional, pattern directed rules, where the conditions are expressed as a conjunction of equations, and the patterns are terms built up of data-constructors and basic values. The computational paradigm in EqL is equation solving. This paper describes EqL informally, by first presenting several examples illustrating the various features of the language: nondeterminism, logical variables, deferred evaluation of primitives, and user-defined constructors. This paper also describes the novel aspects of a sequential implementation for EqL: compile-time flattening and reordering of equations; and run-time equation-delaying, last-equation optimization, and rule indexing. GRA

**N88-19138*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**COMPACT HIGH ORDER SCHEMES FOR THE EULER EQUATIONS Final Report**
Saul Abarbanel (Tel-Aviv Univ., Israel ) and Ajay Kumar Feb. 1988 17 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181625; ICASE-88-13; NAS 1.26:181625) Avail: NTIS HC A03/MF A01 CSCL 09B

An implicit approximate factorization (AF) algorithm is constructed which has the following characteistics. In 2-D: The scheme is unconditionally stable, has a 3 x 3 stencil and at steady state has a fourth order spatial accuracy. The temporal evolution is time accurate either to first or second order through choice of parameter. In 3-D: The scheme has almost the same properties as in 2-D except that it is now only conditionally stable, with the stability condition (the CFL number) being dependent on the cell aspect ratios, delta y/delta x and delta z/delta x. The stencil is still compact and fourth order accuracy at steady state is maintained. Numerical experiments on a 2-D shock-reflection problem show the expected improvement over lower order schemes, not only in accuracy (measured by the L sub 2 error) but also in the dispersion. It is also shown how the same technique is immediately extendable to Runge-Kutta type schemes resulting in improved stability in addition to the enhanced. Author

**N88-19139#** Technische Univ., Berlin (West Germany). Fachbereich Elektrotechnik.
**A PROGRAMMABLE GLOBAL SYSTEM FOR THE MANIPULATION OF RESIDUE NUMBERS Ph.D. Thesis [EIN PROGRAMMIERBARES GESAMTSYSTEM ZUR MANIPULATION VON RESTWERTZAHLEN]**
Theo Rieger 1986 217 p In GERMAN
(ETN-88-91476) Avail: NTIS HC A10/MF A01

A programmable system for the arithmetic of residual classes was developed in order to determine obtainable calculation times in a real complete system for digital signal processing. Considerations and methods for the manipulation and conversion of residue numbers are discussed with respect to their characteristics and the required hardware. The manipulation and conversion methods were implemented using the following hardware components: an arithmetic unit, a binary-to-residue converter, a residue-to-binary converter, a residue-to-analog converter, and an analog-to-residue converter. A microprogrammable control system allows the coordination of hardware component functions, signal flow, and data flow. A processor system permits the development and testing of micro, system, test, and user programs. The obtained computer times are illustrated by a digital, nonrecursive third-order filter. ESA

**N88-19140** Politecnico di Milano (Italy). Dipt. di Elettronica.
**HIGH BIT RATE SERIAL INPUT MUTIPLIERS**
Luigi Dadda 1987 18 p
(Rept-87-012; ETN-88-91652) Avail: Issuing Activity

Serial input multipliers for hardwired VLSI algorithms used in signal applications are considered. It is shown that it is possible to conceive schemes where simple linear arrays of full adders are used, thereby improving the bit rate operation. This can be obtained only if a latency time is accepted. Two schemes are proposed: the first with a latency of two clock periods, the second with a latency of few (the base-two log of the operands length) bits, the latter offering a smaller complexity. Both schemes work with two-complement operands. ESA

**N88-19141** Politecnico di Milano (Italy). Dipartimento di Elettronica.
**A SERIAL INPUT PIPELINED MULTIPLIER**
Luigi Dadda 1987 20 p
(Rept-87-030; ETN-88-91654) Avail: Issuing Activity

A serial input multiplier for the implementation of hardwired algorithms with integrated circuits is proposed. It is characterized by a modular structure, a pipelined operation, two outputs (for the most significant and for the least significant parts of the product), capable of handling two's-complement factors. Factors can be presented in serial form, least significant bit first, or one in serial the other in parallel form. Its complexity is significantly smaller than other schemes (one full adder, five flip-flops per operands bit). ESA

**N88-19142** Politecnico di Milano (Italy). Dipt. di Electtronica.
**FAST SERIAL INPUT-SERIAL OUTPUT PIPELINED INNER PRODUCT UNITS**
Luigi Dadda 1987 18 p
(Rept-87-031; ETN-88-91655) Avail: Issuing Activity

In its shown that inner product units can be implemented with logical schemes where the single products are not realized with separate multipliers, but in an integral form where the inner product is considered as a single, elementary operation. This offers an advantage in circuit complexity when implementing the algorithms in VLSI circuits. ESA

**N88-19143** New South Wales Univ., Kensington (Australia). Dept. of Structural Engineering.
**DYNAMIC ANALYSIS OF PLANE FRAMES BY MICROCOMPUTER Abstract Only. Ph.D. Thesis**
Wai Man Lo Mar. 1987 166 p
Avail: Issuing Activity

Computer dynamic analysis of plane frames subjected to in-plane loading is presented. Only linear analysis is considered, i.e., materials are assumed to remain linear elastic and displacements are assumed to be small during vibration. The main objectives are: to examine the mode superposition method for estimating dynamic response of structural frames; and to develop a computer program on a microcomputer to perform dynamic response analysis of plane frames based on the mode superposition method. The finite element method is utilized to model the frames as an assemblage of individual elements connected at nodal points. The Lagrange equations are employed to develop the system equations of motion based on the consistent mass model. The inverse iteration method is chosen to solve the eigenvalue problem. The system response is estimated by the mode displacement method. The numerical step-by-step integration scheme is based on an exact recursion relation derived from the Duhamel integral. Various simple vibration problems relating to a free cantilever are analyzed using the computer program developed. The results are compared with classical solutions. The dynamic response of a two lane double arch road bridge subjected to a moving load is also estimated by the computer program. The time histories at a few nodal points are plotted and compared with the static influence lines for deflection. Author

**N88-19144#** Lawrence Livermore National Lab., Calif.
**THE LIVERMORE FORTRAN KERNELS: A COMPUTER TEST OF THE NUMERICAL PERFORMANCE RANGE**
Frank H. McMahon Dec. 1986 208 p
(Contract W-7405-eng-48)
(UCRL-53745) Avail: NTIS HC A10/MF A01

A computer performance test that measures a realistic floating-point performance range for FORTRAN applications is described. The problem of benchmarking numerical applications sufficiently, especially on new supercomputers, is analyzed to identify several useful roles for the Livermore FORTRAN Kernel (LFK) test. Examples show how the LFK may be used to study compiled FORTRAN code efficiency, to test the ability of compilers to vectorize FORTRAN, to simulate mature coding of FORTRAN on new computers, and to estimate the effective subrange of supercomputer performance for FORTRAN applications. CPU performance measurements of several FORTRAN benchmarks and numerical applications that correlate well with the CPU performance range measured by the LFK test are presented. The numerical performance metric Mflops, first introduced in 1970, is discussed. Analyses of the LFK performance results argue against reducing the CPU performance range of supercomputers to a single number. The 24 LFK measured rates show a realistic variance in FORTRAN CPU performance that is essential data for circumspect computer evaluations. CPU performance data measured by the LFK test on a number of recent computer systems are tabulated for reference. Author

**N88-19145#** California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Chemistry.
**DOCUMENTATION FOR COMPUTER CODE NACL**
O. Weres, J. C. Peiper, K. S. Pitzer, and R. Pabalan Feb. 1987 34 p
(Contract DE-AC03-76SF-00098)
(LBL-21859; UC-11) Avail: NTIS HC A03/MF A01

The computer program NACL incorporates the empirical model of the thermodynamic properties of the system NaCl - H2O recently published by Pitzer et al. NACL analyzes the experimental data and fixes the parameters in the Pitzer model. NACL calculates values for thermodynamic properties. NACL is written in VAX/VMS FORTRAN with portability in mind. A sample output and full code listing of NACL are appended. J.P.B.

**N88-19146#** Argonne National Lab., Ill. Mathematics and Computer Science Div.
**A THEORY OF PROGRAM CORRECTNESS, AND ALGORITHMS FOR PROOFS**
J. R. Gabriel, R. O. Chapman, and J. L. Kljaich Jan. 1987 18 p
(Contract W-31-109-eng-38)
(ANL-87-4) Avail: NTIS HC A03/MF A01

A model of program correctness is given where a problem domain is defined by its language, variable names, and an abstract machine defining the semantics of the language. The set of all computations in this domain is shown to be a semigroup. A corresponding statement is true of a more general programming language. A program P in the general language is an element of the semigroup. If P performs computations in some domain, a connection can be established between P and the semigroup of computations in that domain. Methods already used in proofs about hardware are shown to be useful in proofs about this software model. The paradigm is capable of reasoning about multiprocessor hardware and of proving theorems about execution times, i.e., performance. Author

**N88-19147*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DISTRIBUTED COMPUTATION OF GRAPHICS PRIMITIVES ON A TRANSPUTER NETWORK**
Graham K. Ellis [1988] 7 p Prepared for presentation at the Summer Computer Simulation Conference, Seattle, Wash., 25-28 Jul. 1988; sponsored in part by The Society for Computer Simulation
(NASA-TM-100814; ICOMP-88-3; E-3999; NAS 1.15:100814)
Avail: NTIS HC A02/MF A01 CSCL 09B

A method is developed for distributing the computation of graphics primitives on a parallel processing network. Off-the-shelf transputer boards are used to perform the graphics transformations and scan-conversion tasks that would normally be assigned to a single transputer based display processor. Each node in the network performs a single graphics primitive computation. Frequently requested tasks can be duplicated on several nodes. The results indicate that the current distribution of commands on the graphics network shows a performance degradation when compared to the graphics display board alone. A change to more computation per node for every communication (perform more complex tasks on each node) may cause the desired increase in throughput. Author

**N88-19148#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**AN EXACT PSEUDO POLYNOMIAL ALGORITHM FOR THE 0-1 LINEAR DIOPHANTINE EQUATION [UM ALGORITMO PSEUDOPOLINOMIAL EXATO PARA A EQUACAO DIOFANTINA LINEAR 0-1]**
Horacio Hideki Yanasse and Nei Yoshihiro Soma (Instituto Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil ) Aug. 1987 8 p In PORTUGUESE; ENGLISH summary Presented at the 10th CNMAC (National Congress of Applied Mathematics and Computation), Gramado, RS, 21-25 Sep. 1987
(INPE-4289-PRE/1160) Avail: NTIS HC A02/MF A01

An extension is presented of Yanasse and Soma's algorithm for the equality constrained knapsack problem with no bounds on the variables, for the case of the 0 to 1 linear diophantine equation. Author

**N88-19149#** Brookhaven National Lab., Upton, N. Y.
**ALGORITHMIC ALTERNATIVES**
M. Creutz Nov. 1987 12 p Presented at the International Symposium on Field Theory on the Lattice, Seillac, France, 28 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003905; BNL-40512; CONF-8709225-2) Avail: NTIS HC A03/MF A01

A large variety of Monte Carlo algorithms are being used for lattice gauge simulations. For purely bosonic theories, present

approaches are generally adequate; nevertheless, overrelaxation techniques promise savings by a factor of about three in computer time. For fermionic fields the situation is more difficult and less clear. Algorithms which involve an extrapolation to a vanishing step size are all quite closely related. Methods which do not require such an approximation tend to require computer time which grows as the square of the volume of the system. Recent developments combining global accept/reject stages with Langevin or microcanonical updatings promise to reduce this growth to V/sup 4/3/. DOE

**N88-19150#** Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.
**AN IBM PC VERSION OF ASENT**
R. W. Ashcraft Dec. 1987 23 p
(Contract DE-AC04-76DP-00487)
(DE88-004244; MHSMP-87-51) Avail: NTIS HC A03/MF A01

ASENT, a FORTRAN program developed by Sandia National Laboratories, Albuquerque, has been converted to Microsoft QuickBASIC for use on the IBM PC. The new version includes a plotting routine which is CGA compatible. A listing of the program and a sample data case are given in the Appendix. DOE

**N88-19151#** Lawrence Livermore National Lab., Calif.
**DATA FLOW GRAPH OPTIMIZATION IN IF1**
S. K. Skedzielewski and M. L. Welcome 2 Dec. 1987 20 p Presented at the 2nd Conference on Functional Programming and Computer Architectures, Nancy, France, 16 Sep. 1985
(Contract W-7405-eng-48)
(DE88-004396; UCRL-92122-Rev-1; CONF-8509440-1-Rev-1)
Avail: NTIS HC A03/MF A01

Optimization techniques are as important when compiling data flow languages as when compiling conventional languages. This paper describes work that has been done on optimizers for SISAL programs that have been translated into IF1 data flow graphs. It shows that conventional optimization algorithms can be easily and efficiently implemented for data flow graphs, and that the payoff for even simple optimizations can be significant. DOE

**N88-19152#** Oak Ridge National Lab., Tenn.
**OPTIMAL CONTROL THEORY OF LOAD-FOLLOWING AND PARAMETER-TRACKING OF NONLINEAR SYSTEMS: AN APPLICATION OF PONTRYAGIN MAXIMUM PRINCIPLE TO REACTOR DYNAMICS**
C. March-Leuba and R. B. Perez Dec. 1987 31 p
(Contract DE-AC05-84OR-21400)
(DE88-004770; ORNL/TM-10662) Avail: NTIS HC A03/MF A01

A demand-following and parameter tracking algorithm has been developed which utilizes the Pontryagin Maximum Principle (PMP). Starting from a variational principle, we have derived the methodology for the construction of a Hamiltonian function, with the analytical properties required by the application of the Pontryagin Maximum Principle method to Free Terminal Time optimization problems. A crucial result has been the conversion of the two point boundary value problem, typical of the Pontryagin Maximum Principle method for nonlinear systems, into a noniterative initial value problem. The introduction of sensor signals information, as a set of differential equations complementing the model's equation, allows the reformulation of parameter tracking algorithms as control optimization problems, where the demands are the plant signals, and the controls are the time-varying plant parameters. The present algorithm allows correction for the time delays which affect the information flowing from the plant. The control algorithm presented in this paper has been validated against a nonlinear mode of a nuclear power plant with time-varying parameters. DOE

**N88-19153#** Argonne National Lab., Ill.
**A TOOL FOR THE ANALYSIS OF QUASI-NEWTON METHODS WITH APPLICATION TO UNCONSTRAINED MINIMIZATION**
R. H. Byrd and J. Nocedal Dec. 1987 15 p
(Contracts W-31-109-eng-38; DE-FG02-87ER-25047)
(DE88-005783; ANL/MCS-TM-103) Avail: NTIS HC A03/MF A01

It is shown that the BFGS update formula has an important property that is independent of the algorithmic context of the update, and that is relevant to both constrained and unconstrained optimization. Also studied are the convergence properties of the BFGS method for unconstrained optimization, using a variety of line searches, including backtracking. Global and superlinear convergence on uniformly convex problems is demonstrated. The analysis is particularly simple due to the use of new tools introduced in this paper. DOE

**N88-19154#** Aeronautical Research Labs., Melbourne (Australia).
**A MAXIMUM LIKELIHOOD PARAMETER ESTIMATION PROGRAM FOR GENERAL NON-LINEAR SYSTEMS**
J. Blackwell Jan. 1988 29 p
(ARL-AERO-TM-392; AR-004-586) Avail: NTIS HC A03/MF A01

A computer program has been developed for the Maximum Likelihood estimation of parameters in general nonlinear systems. Sensitivity matrix elements are calculated numerically, overcoming the need for explicit sensitivity equations. Parameters such as break points and time shifts are successfully determined using both simulated and actual test data. Author

**N88-19155** Gesellschaft fuer Mathematik und Datenverarbeitung, Bonn (West Germany).
**KA-PROLOG: LANGUAGE DEFINITION [KA-PROLOG: SPRACHDEFINITION]**
Norbert Lindenberg, Alexander Bockmayr, Roland Dietrich, Peter Kursawe, Burkhard Neidecker, Carlo Scharnhorst, and Igor Varsek (Karlsruhe Univ., West Germany ) May 1987 54 p In GERMAN Sponsored by Deutsche Forschungsgemeinschaft
(GMD-249; ISSN-0723-0508; ETN-88-91096) Copyright Avail: Issuing Activity

The language definition of KA-Prolog, a dialect of the programming language Prolog, is presented. A syntax of KA-Prolog terms, the programming structure, the run-off control, input and output, arithmetic, predicates, and the standard module are presented. The KA-Prolog language has a modular concept and supports data abstraction and embedding using module-related private data banks and separation between program and data. In comparison with Prolog, this language distinguishes more clearly between procedures defining control structures and procedures describing problems. Design alternatives and decisions are discussed. ESA

**N88-18756#** Joint Publications Research Service, Arlington, Va.
**CHINESE 7760 CAD/CAMM SOFTWARE SYSTEM INTRODUCED**
Xuexun Zhao *In its* JPRS Report: Science and Technology. China 29 Jun. 1987 p 1-7 Transl. into ENGLISH from Guoji Hangkong (International Aviation) (Beijing, China), no. 4, Apr. 87 p 2-4, 58 (For primary document see N88-18755 11-31)
Avail: NTIS HC A06/MF A01

**N88-18781*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A LABELING PROCEDURE FOR LINEAR FINITE-STATE CODES**
K.-M. Cheung *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 50-55 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09B

**N88-18782*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FURTHER RESULTS ON FINITE-STATE CODES**
F. Pollara, K.-M. Cheung, and R. J. McEliece (California Inst. of Tech., Pasadena.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 56-62 (For primary

document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 09B

**N88-19199** Kernforschungsanlage, Juelich (West Germany).
**INCORPORATION OF MULTIGRID IN ACCELERATOR SOFTWARE**
Bernhard Steffen *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 173-188 (For primary document see N88-19187 11-64)
Copyright Avail: Fachinformationszentrum, Karlsruhe, Fed. Republic of Germany

**N88-19200** Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany).
**PERFORMANCE OF A MULTIGRID METHOD ON PARALLEL ARCHITECTURE**
Clemens-August Thole *In its* Multigrid Methods: Special Topics and Applications May 1987 p 189-204 Sponsored by the German Ministry of Research and Development (For primary document see N88-19187 11-64)
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# 62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

**N88-19156#** Utah Univ., Salt Lake City. Dept. of Computer Science.
**A SHARED MEMORY ALGORITHM AND PROOF FOR THE ALTERNATIVE CONSTRUCT IN CSP (COMMUNICATING SEQUENTIAL PROCESSES)**
Richard M. Fujimoto and Hwa-Chung Feng 25 Aug. 1987 37 p
(Contract N00014-87-K-0184)
(AD-A187820; UUCS-87-021) Avail: NTIS HC A03/MF A01 CSCL 12G

Communicating Sequential Processes (CSP) is a paradigm for communication and synchronization among distributed processes. The alternative constructs is a key feature of CSP that allows nondeterministic selection of one among several possible communicants. Previous algorithms for this construct assume a message passing architecture and are not appropriate for multiprocessor systems that feature shared memory. This paper describes a distributed algorithm for the alternative construct that exploits the capabilities of a parallel computer with shared memory. The algorithm assumes a generalized version of Hoare's original alternative construct that allows output commands to be included in guards. A correctness proof of the proposed algorithm is presented to show that the algorithm conforms to some safety and liveness criteria. Extensions to allow termination of processes and to ensure fairness in guard selection are also given. GRA

**N88-19157#** North Carolina Univ., Chapel Hill. Dept. of Computer Science.
**IMPLEMENTING DYNAMIC ARRAYS: A CHALLENGE FOR HIGH-PERFORMANCE MACHINES**
Gyula Mago and Will Partain 1986 3 p
(Contract DAAL03-86-G-0050)
(AD-A188142) Avail: NTIS HC A02/MF A01 CSCL 12F

There is an increasing need for high-performance artificial intelligence (AI) machines. What is unusual about AI is that its programs are typically dynamic in the way their execution unfolds and in the data structures they use. AI therefore needs machines that are late-binding. Multiprocessors are often held out as the answer to AI's computing requirements. However, most success with multiprocessing has come from exploiting numerical computations' basic data structure-the static array (as in FORTRAN). A static array's structure does not change, so its elements (and the processing on them) may be readily distributed. In AI, the ability to change and manipulate the structure of data is paramount; hence, the pre-eminence of the LISP list. Unfortunately, the traditional pointer-based list has serious drawbacks for distributed processing. The dynamic array is a data structure that allows random access to its elements (like static arrays) yet whose structure-size and dimensions-can be easily changed, i.e., bound and re-bound at run-time. It combines the flexibility that AI requires with the potential for high performance through parallel operation. A machine's implementation of dynamic arrays gives a good insight into its potential usefulness for AI applications. Therefore, the authors outline the implementation of dynamic arrays on a machine that we are developing. GRA

**N88-19158#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**PARALLEL PROCESSING IN NONLINEAR PROGRAMMING [PROCESSAMENTO PARALELO EM PROGRAMACAO NAO-LINEAR]**
Ana ClaradaMota and Luiz Antonio Nogueir Lorena Aug. 1987 22 p In PORTUGUESE; ENGLISH summary Presented at the 16th Brazilian Congress of Mathematics, Rio de Janeiro, Brazil, 19-25 Jul.
(INPE-4298-PRE/1169) Avail: NTIS HC A03/MF A01

The appearance of parallel computers is a challenge for numerical analysis and optimization. In this work a survey is made of parallel unconstrained optimization methods. Conjugate directions and Newton methods are presented for some of the main architectures of parallel computers. Author

# 63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

**N88-19159#** RAND Corp., Santa Monica, Calif.
**EVALUATING EXPERT SYSTEM TOOLS: A FRAMEWORK AND METHODOLOGY-WORKSHOPS Interim Report**
Jeff Rothenberg, Jody Paul, Kameny, Iris, James R. Kipps, and Marcy Swenson Jul. 1987 164 p
(Contract MDA903-85-C-0030)
(AD-A187190; RAND/N-2603-DARPA) Avail: NTIS HC A08/MF A01 CSCL 12C

This Note describes two workshops held at The RAND Corporation in June and November 1986 in conjunction with a study conducted for the Information Science and Technology Office of the Defense Advanced Research Projects Agency (DARPA), under RAND's National Defense Research Institute (NDRI). The NDRI is a Federally Funded Research and Development Center sponsored by the Office of the Secretary of Defense. The study was undertaken to develop criteria for evaluating and selecting tools used to build expert systems. The note should be of interest primarily to decisionmakers concerned with choosing such tools, i.e., managers of expert system development projects and developers of expert system techniques. GRA

**N88-19160#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**TYPICAL: A KNOWLEDGE REPRESENTATION SYSTEM FOR AUTOMATED DISCOVERY AND INFERENCE**
Kenneth W. Haase, Jr. Aug. 1987 104 p
(Contract N00014-85-K-0124)
(AD-A187483; AI-TR-988) Avail: NTIS HC A06/MF A01 CSCL 12E

TYPICAL is a package for describing and making automatic inferences about a broad class of SCHEME predicate functions. These functions, called types following popular usage, delineate classes of primitive SCHEME objects, composite data structures and abstract descriptions. TYPICAL types are generated by an extensible combinator language from either existing types of primitive terminals. These generated types are located in a lattice of predicate subsumption which captures necessary entailment

between types; if satisfaction of one type necessarily entails satisfaction of another, the first type is below the second in the lattice. The inferences made by TYPICAL are relations in this lattice of subsumption; when a type is defined, TYPICAL computes the position of the new definition in the lattice and establishes it there. This information is then accessible to both later inferences and other programmes (reasoning systems, code analyzers, etc.) which may need the information for their own purposes. TYPICAL was developed as a representation language for the discovery programme CYRANO; particular examples are given of TYPICAL's application in the CYRANO programme. GRA

**N88-19161#** Naval Research Lab., Washington, D.C.
**THE CHOICE OF LEARNING STRATEGY IN AN AUTONOMOUS SYSTEM Interim Report**
Diana F. Gordon 5 Oct. 1987 30 p
(AD-A187707; NRL-9075) Avail: NTIS HC A03/MF A01
CSCL 23B

Machine learning is a relatively new field within artificial intelligence. Most of the work to date has concentrated on individual learning strategies. Autonomous systems such as robots, however, require a variety of techniques. This report addresses the problem of strategy choice within a multistrategy system. Learning techniques are first categorized along five dimensions. Afterwards, a description is given of potential sources of constraints on the choice of strategy. Finally, existing learning systems that use multiple strategies are critiqued. GRA

**N88-19162#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
**TWO NEW FRAMEWORKS FOR LEARNING Technical Report**
B. K. Natarajan Nov. 1987 17 p
(AD-A187723; CMU-RI-TR-87-25) Avail: NTIS HC A03/MF
A01 CSCL 12B

This paper presents two new formal frameworks for learning. The first framework requires the learner to approximate an unknown function, given examples for the function as well as some background information on it. It is shown that this framework is no more powerful than a framework that allows the learner to see examples but not background information. The second framework explores learning in the sense of improving computational efficiency as opposed to acquiring an unknown concept or function. Specifically, the framework concerns the acquisition of heuristics for examples over problem domains of special structure. A theorem is proved identifying some conditions sufficient to allow the efficient acquisition of heuristics over the aforementioned class of domains. GRA

**N88-19163#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
**LEARNING FUNCTIONS FROM EXAMPLES Interim Report**
B. K. Natarajan Aug. 1987 19 p
(AD-A187725; CMU-RI-TR-87-19) Avail: NTIS HC A03/MF
A01 CSCL 12I

This paper concerns algorithms that learn functions from examples. Functions on strings of a finite alphabet are considered and the notion of dimensionality defined for families of such functions. Using this notion, a theorem is proved identifying the most general conditions under which a family of functions can be efficiently learned from examples. Turning to some familiar families, we present strong evidence against the existence of efficient algorithms for learning the regular functions and the polynomial time computable functions, even if the size of the encoding of the function to be learned is given. Our arguments hinge in a new complexity measure--the constraint complexity. GRA

**N88-19164#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
**OBJECT RECOGNITION ON A SYSTOLIC ARRAY**
Claire M. Bono and Jon A. Webb Sep. 1987 22 p
(Contracts N00014-80-C-0236; F33615-81-K-1539)
(AD-A187726; CMU-RI-TR-87-21) Avail: NTIS HC A03/MF
A01 CSCL 12G

Computer vision systems for recognition include both the extraction of features and the matching of those features with a known model. Traditionally, the most time consuming has been feature extraction, but new parallel architectures are removing the bottleneck at this level. Once features have been extracted from an image considerable geometric search is still necessary to form relationships between the extracted features and to match those features and feature aggregates with a model. One can take advantage of certain constraints about the appearance of an object, but with complex images or multiple models intensive processing is still required. We have developed some algorithms for doing these geometric search operations in parallel on iWarp, a long linear array of VLSI processing elements currently being designed by Carnegie Mellon and Intel Corporation. We have simulated a system which uses these algorithms to do an object recognition task (after low-level vision) almost completely on a 72 processor iWarp array. An analysis of this system indicates a speedup by a factor of roughly 100 to 250 over a sequential version running on a VAX 8650. GRA

**N88-19165#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**ERROR DETECTION AND RECOVERY FOR ROBOT MOTION PLANNING WITH UNCERTAINTY Ph.D. Thesis**
Bruce R. Donald Jul. 1987 314 p
(Contracts N00014-85-K-0124; N00014-82-K-0334)
(AD-A187746; AI-TR-982) Avail: NTIS HC A14/MF A01
CSCL 12I

Robots must plan and execute tasks in the presence of uncertainty. Uncertainty arises from sensing errors, control errors, and uncertainty in the geometry of the environment. The last, which is called model error, has received little previous attention. This document presents a framework for computing motion strategies that are guaranteed to succeed in the presence of all three kinds of uncertainty. The motion strategies comprise sensor-based gross motions, compliant motions, and simple pushing motions. It is not always possible to find plans that are guaranteed to succeed. For example, if tolerancing errors render an assembly infeasible, the plan executor should stop and signal failure. In such cases the insistence on guaranteed success is too restrictive. For this reason Error Detection and Recovery (EDR) strategies, there is no possibility that the plan will fail without the executor realizing it. The EDR framework fills a gap when guaranteed plans cannot be found or do not exist: it provides a technology for constructing plans that might work, but fail in a reasonable way when they cannot. GRA

**N88-19166#** California Univ., Irvine. Dept. of Information and Computer Science.
**CONCEPTS AND NOMENCLATURE IN THE WORLD MODELING SYSTEM (A LESSON IN APPLIED METAPHYSICS) Interim Report, Jan. 1985 - Jan. 1986**
Greg Hood Oct. 1987 11 p
(Contract MDA903-85-C-0324; DA Proj. 2Q1-61102-B-74-F)
(AD-A188246; ARI-RN-87-49) Avail: NTIS HC A03/MF A01
CSCL 12I

This research note provides the nomenclature information necessary to create a World Modeling organism or simulation. Nomenclature for worlds, objects, organisms, views, images, times, and states is provided. Information on checkpointing, tracing, creating log and image files, implementation guidelines, and file formats is also included. GRA

**N88-19167*#** Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
**RESEARCH ON OUTPUT FEEDBACK CONTROL Final Report**
Anthony J. Calise Feb. 1988 23 p
(Grant NAG1-243)
(NASA-CR-182543; NAS 1.26:182543) Avail: NTIS HC
A03/MF A01 CSCL 09B

A summary is presented of the main results obtained during the course of research on output feedback control. The term output feedback is used to denote a controller design approach which

does not rely on an observer to estimate the states of the system. Thus, the order of the controller is fixed, and can even be zero order, which amounts to constant gain ouput feedback. The emphasis has been on optimal output feedback. That is, a fixed order controller is designed based on minimizing a suitably chosen quadratic performance index. A number of problem areas that arise in this context have been addressed. These include developing suitable methods for selecting an index of performance, both time domain and frequency domain methods for achieving robustness of the closed loop system, developing canonical forms to achieve a minimal parameterization for the controller, two time scale design formulations for ill-conditioned systems, and the development of convergent numerical algorithms for solving the output feedback problem. Author

**N88-19168*#** Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
**DESIGN FOR PERFORMANCE ENHANCEMENT IN FEEDBACK CONTROL SYSTEMS WITH MULTIPLE SATURATING NONLINEARITIES Ph.D. Thesis**
Petros Kapasouris Mar. 1988 230 p Sponsored in part by the General Electric Corporate Research and Development Center
(Grant NAG2-297)
(NASA-CR-182614; NAS 1.26:182614; LIDS-TH-1757) Avail: NTIS HC A11/MF A01 CSCL 09B

A systematic control design methodology is introduced for multi-input/multi-output systems with multiple saturations. The methodology can be applied to stable and unstable open loop plants with magnitude and/or rate control saturations and to systems in which state limitations are desired. This new methodology is a substantial improvement over previous heuristic single-input/single-output approaches. The idea is to introduce a supervisor loop so that when the references and/or disturbances are sufficiently small, the control system operates linearly as designed. For signals large enough to cause saturations, the control law is modified in such a way to ensure stability and to preserve, to the extent possible, the behavior of the linear control design. Key benefits of this methodology are: the modified compensator never produces saturating control signals, integrators and/or slow dynamics in the compensator never windup, the directional properties of the controls are maintained, and the closed loop system has certain guaranteed stability properties. The advantages of the new design methodology are illustrated by numerous simulations, including the multivariable longitudinal control of modified models of the F-8 (stable) and F-16 (unstable) aircraft. Author

# 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N88-19169#** Mississippi State Univ., Mississippi State. Dept. of Aerophysics and Aerospace Engineering.
**GENERATION OF SURFACE GRIDS THROUGH ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS FOR AIRCRAFT AND MISSILE CONFIGURATIONS Interim Report, Apr. 1986 - Jun. 1987**
Z. U. Warsi Jul. 1987 25 p
(Grant AF-AFOSR-87-1468TR)
(AD-A186631; ASE-87-312; AFOSR-87-1468TR) Avail: NTIS HC A03/MF A01 CSCL 12A

Numerical solution of the partial differential equations for the generation of surface grids requires a specification of the forcing function which depends on the geometry of the given surface. The data for the surface is usually in discrete form. Methods have been developed which fit a function over the given data. For complicated shapes, e.g., an airplane, the functional fit and the eventual grid generation for the fuselage and wings are done separately and then integrated later. GRA

**N88-19170*#** Texas Univ. at Dallas, Richardson.
**CANONICAL COORDINATES FOR PARTIAL DIFFERENTIAL EQUATIONS**
L. R. Hunt and Ramiro Villarreal [1987] 15 p
(Grant NAG2-366)
(NASA-CR-182486; NAS 1.26:182486) Avail: NTIS HC A03/MF A01 CSCL 12A

Necessary and sufficient conditions are found under which operators of the form Sigma(m, j=1) X(2)sub j + X sub 0 can be made constant coefficient. In addition, necessary and sufficient conditions are derived which classify those linear partial differential operators that can be moved to the Kolmogorov type. M.G.

**N88-19171*#** Texas Univ. at Dallas, Richardson. Programs in Mathematical Sciences.
**NONLINEAR INPUT-OUTPUT SYSTEMS**
L. R. Hunt, Mladen Luksic, and Renjeng Su (Colorado Univ., Boulder.) [1987] 4 p Sponsored in part by the National Science Foundation
(Grant NAG2-366)
(NASA-CR-182484; NAS 1.26:182484) Avail: NTIS HC A02/MF A01 CSCL 12A

Necessary and sufficient conditions that the nonlinear system dot-x = f(x) + ug(x) and y = h(x) be locally feedback equivalent to the controllable linear system dot-xi = A xi + bv and y = C xi having linear output are found. Only the single input and single output case is considered, however, the results generalize to multi-input and multi-output systems. M.G.

**N88-19172*#** National Aeronautics and Space Administration, Washington, D.C.
**ESTIMATES OF GREEN TENSORS FOR CERTAIN BOUNDARY VALUE PROBLEMS**
V. Solonnikov Feb. 1988 12 p Transl. into ENGLISH from Doklady Akademii Nauk SSSR (USSR), v. 130, no. 5, 1960 p 988-991 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20203; NAS 1.77:20203) Avail: NTIS HC A03/MF A01 CSCL 12A

Consider the first boundary value problem for a stationary Navier-Stokes system in a bounded three-dimensional region Omega with the boundary S: delta v = grad p+f, div v=0, v/s=0. Odqvist (1930) developed the potential theory and formulated the Green tensor for the above problem. The basic singular solution used by Odqvist to express the Green tensor is given. A theorem generalizing his results is presented along with four associated theorems. A specific problem associated with the study of the differential properties of the solution of stationary problems of magnetohydrodynamics is examined. M.G.

**N88-19173#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**ANALYSIS OF LEARNING CURVE FITTING TECHNIQUES M.S. Thesis**
Charles R. Avinger Sep. 1987 88 p
(AD-A187680; AFIT/GSM/LSQ/87S-3) Avail: NTIS HC A05/MF A01 CSCL 05C

This thesis was basic research on learning curve fitting techniques. The unit formulation of the learning curve was fit using two parametric techniques, ordinary least-squares and weighted least-square, and two nonparametric techniques, called median slope and mean slope. Comparisons were made between the techniques in four data cases, equal and unequal lot sizes with normally distributed error terms and equal and unequal lot sizes with triangularly distributed error terms. The Cauchy error term distribution was tried but rejected. The fitting techniques were compared on their estimation of the formula parameters, the dispersion of the data points around the fitted line and their predictions of future costs. Analysis showed that in cases of equal lot sizes, ordinary least-squares has the most bias, but still is a good predictor of future costs. In cases of unequal lot sizes the weighted least-squares and the ordinary least-squares techniques

performed well. Ordinary least-squares estimated the parameters with the least bias but had prediction errors that increased with the unit numbers. Weighted least-squares estimated the parameters with the most bias and had prediction errors that, on average, started high and turned low as the unit number got larger. The nonparametric techniques did a better job of predicting future cost, in that the mean predictions were closer to the population costs. However, these techniques had wider ranges of predictions.
GRA

**N88-19174#** Naval Underwater Systems Center, New London, Conn.
**ACCURATE EFFICIENT EVALUATION OF BESSEL TRANSFORM: PROGRAMS AND ERROR ANALYSIS Technical Report**
Albert H. Nuttall 11 Sep. 1987 73 p
(AD-A187718; NUSC-TR-8027) Avail: NTIS HC A04/MF A01 CSCL 12C

The method of Filon numerical integration for Fourier transforms is extended to Bessel transforms of a certain form for general g(x). Specifically, for the two cases where g(x) is approximated by straight lines, or parabolas, over abutting panels, the corresponding integrals in the Bessel transform G(omega) are evaluated exactly (within computer round-off error). Although these integrals cannot be expressed in closed form (as for Filon's case), a recursive procedure and an asymptotic expansion yield rapid accurate evaluation of the required quantities. Programs are furnished for both cases in BASIC. Furthermore, two versions of each are furnished: a faster one requiring considerable storage, and a slower one requiring very little storage. The presence and location of aliasing is predicted and its magnitude is investigated numerically. The error dependence on the panel width used in both cases (a) and (b) is established by means of numerical examples, one with a very fast decay with omega, the other with a very slow decay with omega. approximation.
GRA

**N88-19175#** Tennessee Univ., Knoxville.
**CONFERENCE ON MAXIMUM PRINCIPLES AND EIGENVALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS Final Report, 1 Jun. - 30 Sep. 1987**
Philip W. Schaefer 30 Sep. 1987 12 p Conference held in Knoxville, Tenn. 15-19 Jun. 1987
(Grant AF-AFOSR-0275-87)
(AD-A187870; AFOSR-87-1685TR) Avail: NTIS HC A03/MF A01 CSCL 21A

New results in the extension of maximum principles to systems using best possible estimates were the high light topic. These apply to equations in continuum mechanics.
GRA

**N88-19176#** Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
**OPTIMAL RECURSIVE MAXIMUM LIKELIHOOD ESTIMATION**
Lennart Ljung, Sanjoy K. Mitter, and Jose M. Moura Mar. 1987 2 p
(Grant AF AFOSR-0227-85)
(AD-A187980; LIDS-P-1660; AFOSR-87-1495TR) Avail: NTIS HC A02/MF A01 CSCL 12C

This paper derives stochastic differential equations for recursive maximum likelihood estimates for the joint filtering parameter estimation problem.
GRA

**N88-19177#** California Univ., Berkeley. Operations Research Center.
**DE FINETTI'S APPROACH TO GROUP DECISION MAKING**
Richard E. Barlow, Sergio Wechsler, and Fabio Spizzichino Jun. 1987 23 p
(Contract DAAG29-85-K-0208)
(AD-A188074; ORC-87-13; ARO-22735.5-MA) Avail: NTIS HC A03/MF A01 CSCL 12D

A group of Bayesians must make a group decision; e.g., choose one of two final actions. De Finetti considered group decision making, relative to a special sequential decision problem, when all individuals have the same loss function but different opinions. In particular, he defined the individual horizon and the common horizon relative to a given group decision role such as a voting rule. He characterized voting rules as an average of decisions and argued that it is better for the group to use an average of opinions.
GRA

**N88-19178#** Florida State Univ., Tallahassee. Dept. of Statistics.
**SOME MAJORIZATION INEQUALITIES FOR FUNCTIONS OF EXCHANGEABLE RANDOM VARIABLES**
Philip J. Boland, Frank Proschan, and Y. L. Tong Oct. 1987 15 p
(Contract F49620-85-C-0007; Grant NSF DMS-85-02346)
(AD-A188207; FSU-TR-M769; AFOSR-87-1599TR; AFOSR-TR-87-212) Avail: NTIS HC A03/MF A01 CSCL 12C

This paper contains inequalities for the exceptions of permutation-invariant concave functions of the partial sums of nonnegative exchangeable random variables. Two majorization inequalities are derived, and an application in reliability theory is discussed.
GRA

**N88-19179#** Nauchno-Issledovatetskij Inst. Atomnykh Reaktororov, Dimitrovgrad (USSR).
**SUBROUTINES FOR SOLVING THE EQUATION OF DIFFUSION IN MEDIA WITH ANISOTROPIC PROPERTIES**
V. D. Grachev and R. R. Melder 1986 14 p In RUSSIAN
(DE88-700743; NIIAR-29-710) Avail: NTIS (US Sales Only) HC A03/MF A01

The calculational method and the subprograms necessary for the solution of the diffusion equation in a medium with anisotropic properties are described. The finite element method using piecewise linear approximation of the test functions is used. The application of local coordinate systems aligned with the main isotropic axis is shown to simplify substantially the statement of the problem and its solution. Using the subprograms described, the coolant rate is calculated in the space between the fuel elements and the temperature field of the fuel. The subprograms enter the complex of the subprograms of the thermophysical calculation of radiation devices and fuel assemblies of nuclear reactors.
DOE

**N88-19180#** Institut Franco-Allemand de Recherches, St. Louis (France).
**A NUMERICAL PROCEDURE FOR CONFORMAL MAPPING OF THE EXTERIOR OF A CIRCLE ONTO THE EXTERIOR OF A WING PROFILE WITH A SPOILER [EIN NUMERISCHE VERFAHREN ZUR BERECHNUNG DER KONFORMEN ABBILDUNG DES AEUSSEREN EINES KREISES AUF DAS AEUSSERE EINES TRAGFLUEGELS MIT SPOILER UN PROCEDE NUMERIQUE POUR LA TRANSFORMATION CONFORME DE L'EXTERIEUR D'UN CERCLE EN L'EXTERIEUR D'UN]**
W. Czichowsky 7 Apr. 1986 104 p In FRENCH and GERMAN
(ISL-R-110/86; ETN-88-91640) Avail: NTIS HC A06/MF A01

The Theodorsen method for mapping a circle onto a wing profile is described. The product is a Poisson equation which is solved using Fourier series whose coefficients are calculated by the method of discontinuities. The Schwarz-Christoffel method for the transformation of the interior and exterior of polygons is outlined, and the parameter problem is formulated. Potential flow around polygons is analyzed. An iterative method for mapping the exterior of a circle to the exterior of a polygon is indicated. Numerical results for the RA 16-SC1 wing profile with a 40 deg spoiler are presented.
ESA

**N88-19181** Politecnico di Milano (Italy). Dipt. di Elettronica.
**ON SERIAL-INPUT MULTIPLIERS FOR TWO-COMPLEMENT NUMBERS**
Luigi Dadda 1986 19 p
(Rept-86-035; ETN-88-91651) Avail: NTIS HC A03/MF A01

Serial input multipliers for hardwired VLSI algorithms used in signal applications are considered. It is shown that a multiplier

proposed for unsigned numbers can be used for two-complement numbers as well, provided only that the content of the input registers is held constant, after the introduction of the operands sign bits, for a number of clock periods equal to the operands length (minus one). The result is derived by the properties of sign-extended two-complement numbers. ESA

**N88-19182*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ACCURATE BOUNDARY CONDITIONS FOR EXTERIOR PROBLEMS IN GAS DYNAMICS**
Thomas Hagstrom and S. I. Hariharan (Akron Univ., Ohio.) Mar. 1988 24 p
(Grant NSF DMS-86-04047)
(NASA-TM-100807; ICOMP-88-2; E-3988; NAS 1.15:100807)
Avail: NTIS HC A03/MF A01 CSCL 12A

The numerical solution of exterior problems is typically accomplished by introducing an artificial, far field boundary and solving the equations on a truncated domain. For hyperbolic systems, boundary conditions at this boundary are often derived by imposing a principle of no reflection. However, waves with spherical symmetry in gas dynamics satisfy equations where incoming and outgoing Riemann variables are coupled. This suggests that natural reflections may be important. A reflecting boundary condition is proposed based on an asymptotic solution of the far field equations. Nonlinear energy estimates are obtained for the truncated problem and numerical experiments presented to validate the theory. Author

**N88-19183#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**A UNIFIED APPROACH FOR DIGITAL IMAGE PROCESSING PROBLEMS: MATHEMATICAL MORPHOLOGY M.S. Thesis**
Junior Barrera Aug. 1987 167 p In PORTUGUESE; ENGLISH summary
(INPE-4311-TDL/278) Avail: NTIS HC A08/MF A01

Presented is a mathematical tool, Mathematical Morphology, based on set theory, which is useful in solving many problems in image processing. In fact, this tool is a unified approach to dealing with image processing problems of different kinds (restoration, segmentation, analysis, coding, etc.), which were previously treated by using specific algorithms. This thesis also presents a computational system, developed at INPE, based on Mathematical Morphology operations and some problems of image processing solved with this system. Author

**N88-19184*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**AN O(N SQUARED) METHOD FOR COMPUTING THE EIGENSYSTEM OF N BY N SYMMETRIC TRIDIAGONAL MATRICES BY THE DIVIDE AND CONQUER APPROACH Final Report**
Doron Gill and Eitan Tadmor (Tel-Aviv Univ., Israel ) Mar. 1988 25 p Sponsored in part by Tel Aviv Univ., (Israel) Submitted for publication
(Contract NAS1-18107; Grants NSF DMS-85-0294; DAAG-85-K-0190)
(NASA-CR-181647; ICASE-88-19; NAS 1.26:181647) Avail: NTIS HC A03/MF A01 CSCL 12A

An efficient method is proposed to solve the eigenproblem of N by N Symmetric Tridiagonal (ST) matrices. Unlike the standard eigensolvers which necessitate O(N cubed) operations to compute the eigenvectors of such ST matrices, the proposed method computes both the eigenvalues and eigenvectors with only O(N squared) operations. The method is based on serial implementation of the recently introduced Divide and Conquer (DC) algorithm. It exploits the fact that by O(N squared) of DC operations, one can compute the eigenvalues of N by N ST matrix and a finite number of pairs of successive rows of its eigenvector matrix. The rest of the eigenvectors--all of them or one at a time--are computed by linear three-term recurrence relations. Numerical examples are presented which demonstrate the superiority of the proposed method by saving an order of magnitude in execution time at the expense of sacrificing a few orders of accuracy. Author

**N88-19185#** Los Alamos National Lab., N. Mex.
**BOLTZMANN-FOKKER-PLANCK CALCULATIONS USING STANDARD DISCRETE-ORDINATES CODES**
J. E. Morel 1987 16 p Presented at the Computational Methods in High Temperature Physics, Los Alamos, N. Mex., 2 Feb. 1987
(Contract W-7405-eng-36)
(DE88-005393; LA-UR-88-229; CONF-8702113-2) Avail: NTIS HC A03/MF A01

The Boltzmann-Fokker-Planck (BFP) equation can be used to describe both neutral and charged-particle transport. Over the past several years methods have been developed for representing Fokker-Planck operators with standard multigroup-Legendre cross-section data. When these data are input to a standard S(sub n) code such as ONETRAN, the code actually solves the Boltzmann-Fokker-Planck equation rather than the Boltzmann equation. This is achieved wihout any modification to the S(sub n) codes. Because BFP calculations can be more demanding from a numerical viewpoint than standard neutronics calculations, we have found it useful to implement new quadrature methods and convergence acceleration methods in the standard discrete-ordinates code, ONETRAN. We discuss our BFP cross-section representation techniques, our improved quadrature and acceleration techniques, and present results from BFP coupled electron-photon transport calculations performed with ONETRAN. DOE

**N88-19186#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**WKBJ METHOD AND STRAINED COORDINATES FOR HIGH FREQUENCY INERTIAL WAVE FILTERING [METODO WKBJ E DAS COORDENADAS ESTICADAS PARA FILTRAR ONDAS INERCIAIS DE ALTA FREQUENCIA]**
Kioshi Hada and Stanley Jacobs Jul. 1987 8 p In PORTUGESE Presented at the 10th National Congress of Applied Mathematics and Computation, Gramado, RS, 21-25 Sep. 1987
(INPE-4214-PRE/1095) Avail: NTIS HC A02/MF A01

A high frequency inertial wave filtering method is presented. The WKBJ and strained coordinate methods were used to obtain low frequency inertial waves in a homogeneous and spherical shaped mass in rotation about an imaginary axis passing through the center of mass. The eigenvalue and eigenfunction calculation by this method is much easier than Greenspan's. The agreement is good within an error of approximately four percent. Author

**N88-19187** Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany).
**MULTIGRID METHODS: SPECIAL TOPICS AND APPLICATIONS**
Ulrich Trottenberg, ed. and Wolfgang Hackbusch, ed. May 1987 197 p Presented at the 2nd European Conference on Multigrid Methods, Cologne, Fed. Republic of Germany, 1-4 Oct. 1985
(GMD-120; ISBN-3-88457-120-6; ISSN-0170-8120; ETN-88-91432)
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Multigrid methods, implementation of multigrid algorithms, and multigrid solutions for the Euler and Navier-Stokes equations were discussed. Fluid dynamics and aerodynamics; multigrid approaches to convex optimization; the treatment of unstructured finite element meshes in a multigrid framework; multigrid methods for the computation of eigenvalues of the Maxwell equations; and the possibility of using different discretization schemes on different multigrid levels were considered. For individual titles, see N88-19188 through N88-19201.

**N88-19188** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**A GENERALISATION OF HALL'S SCHEME FOR SOLVING THE EULER EQUATIONS FOR TWO-DIMENSIONAL FLOWS** c34
M. T. Arthur *In* Gesellschaft fuer Mathematik und

Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 7-23 (For primary document see N88-19187 11-64)
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Hall's (1985) cell-vertex multigrid scheme for solving the Euler equations for the flow over an airfoil was modified to remove restrictions on the number of multigrid levels and the number of intervals. Results of calculations of the flow over airfoil RAE 2822 at Mach number = 0.75 and angle of incidence = 3.0 deg for a range of grid sequences are presented. The results show that the increased flexibility of the scheme may be obtained at little or no extra cost, despite the necessarily more complex form of the algorithm that is required. ESA

**N88-19189** Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany). Inst. fuer Methodische Grundlagen.
**A MULTIGRID SOLVER FOR TWO-DIMENSIONAL TRANSONIC FULL POTENTIAL FLOW CALCULATIONS** c02
K. Becker *In its* Multigrid Methods: Special Topics and Applications May 1987 p 25-34 (For primary document see N88-19187 11-64)
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The calculation of potential flow around airfoils at subsonic free stream velocity is discussed. Multigrid (MG) problems arise in the calculation of transonic two-dimensional full potential flow, due to dependency of convergence factors on problem-dependent parameters. Dependency is caused by lack of smoothing in the relaxation algorithm for the hyperbolic equations. This can be overcome by introducing a direct or explicit type of relaxation, which however can be divergent for Fourier components. A combination of both gives fairly good results. As the maximum Mach number is increased further the convergence properties change abruptly. A pulsing of the supersonic region (i.e., the shock location) can be observed which results in a convergence factor of 1. The fine grid smoothing and the coarse grid correction processes seem to fight against each other. The reason is in the MG-treatment of the shock position. The very high nonlinearity of the position seems to make the solution very sensitive to perturbations naturally introduced by relaxation or coarse grid correction interpolations. A change of discretization may be necessary. ESA

**N88-19190** Provence Univ., Marseille (France). UER de Mathematiques.
**MULTIGRID METHODS IN CONVEX OPTIMIZATION**
R. Boyer and B. Martinet *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 35-47 (For primary document see N88-19187 11-64)
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A two-grid algorithm for which the smoothing step is formed by iterations of a convergent descent method while the coarse grid correction is an adaptation of the Hackbusch (1982) method for general nonlinear problems, in order to obtain a descent, is derived. It is proved that a such method is globally convergent and that asymptotically the study of its convergence factor leads to wellknown results. This result can be extended to a problem with linear equality constraints. Problems where the admissible set is a positive cone are treated. Optimization methods founded on penalty or Lagrange multipliers for which the intermediate problems (without constraints or with very simple constraints) can be solved by multigrid methods are mentioned. ESA

**N88-19191** Ruhr Univ., Bochum (West Germany). Inst. fuer Thermo- und Fluiddynamik.
**IMPLEMENTATION OF MULTIGRID IN SOLA ALGORITHM** c34
U. Brockmeier, N. K. Mitra, and M. Fiebig *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 49-61 (For primary document see N88-19187 11-64)
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A multigrid computational scheme for the pressure iteration of the marker and cell (SOLA) computation of three dimensional fluid flows is presented. Test cases were calculated with multigrid techniques. Results show a saving of computer time of 80 to 90 percent with multigrid computation vis-a-vis single grid computations. ESA

**N88-19192** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
**SOLUTION OF THE EULER EQUATIONS: EXPLICIT SCHEMES ACCELERATION BY A MULTIGRID METHOD**
V. Couaillier *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 63-84 (For primary document see N88-19187 11-64)
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A multigrid formulation for hyperbolic systems is proposed. The stability of a one dimensional scheme with two grids was studied by a Fourier analysis suitable to the multigrid method. The scheme used for integrating the residual equation on the coarse grids stems from the Ni (1982) method in which time parameters are introduced to optimize the convergence rate. The one dimensional study was used to determine optimal coefficients. Use of these coefficients for solving the Euler equations in two dimensions confirms their usefulness for getting a better convergence rate. A bilinear interpolation technique improves the behavior of the multigrid method on strongly curvilinear meshes. The multigrid method is presented under a formulation which is useful to build schemes for integrating the residual equation. ESA

**N88-19193*** Berkeley Research Association, Springfield, Va.
**UNSTRUCTURED MULTIGRID METHODS**
R. Loehner and K. Morgan (University Coll. of Swansea, Wales ) *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 87-94 (For primary document see N88-19187 11-64)
(Grant NAGw-478)
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The use of the multigrid procedure with a sequence of unnested coarser grids is discussed. Validity of the procedure is assessed by considering the solution of a single linear elliptic equation. It is demonstrated how a scheme with the optimum order of operations can be constructed. Application to the solution of the Euler equations is considered. ESA

**N88-19194** Manchester Univ. (England). Dept. of Mathematics.
**SOLUTION OF A ROTATING NAVIER-STOKES PROBLEM BY A NONLINEAR MULTIGRID ALGORITHM** c34
F. Lonsdale *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 95-109 (For primary document see N88-19187 11-64)
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The solution of a simplified version of a problem in gas turbine design, the flow of air between rotating disks, by a nonlinear multigrid algorithm is treated. The problem considered is that of laminar source-sink flow between corotating disks as in Chew (1984) and Lonsdale and Walsh (1984). The extended pressure correction scheme of Van Doormaal and Raithby (1984) was analyzed as a smoother for the Navier-Stokes and continuity equations. It gives much improved convergence rates compared with an efficient one-grid method (which included the use of a linear multigrid algorithm in part of the solution process). The convergence in a computational cost proportional to the number of grid points is achieved. ESA

**N88-19195** Israel Aircraft Industries Ltd., Lod.
**A MULTIGRID FULL POTENTIAL TRANSONIC CODE FOR ARBITRARY CONFIGURATIONS** c02
A. L. Luntz and B. Epstein *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 111-120 (For primary document see N88-19187 11-64)
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A three dimensional transonic code for arbitrary aerodynamic configurations using only cartesian mesh grids is described. The code consists of two main programs. The first of these (PREPRO) translates the geometry of the aircraft configuration in terms of computational grids. The output of PREPRO, together with physical and computational parameters, serves as input to the second main program (MULTIG) which actually performs the aerodynamic computation. The aircraft configuration is defined as an assembly of elements. The following types of elements are allowed: bodies (fuselage, external fuel tank, etc.) wings (also canards, horizontal tail, etc.) pylons and fins, nacelles. Several elements of one type may be present in one configuration. Computational results for different configurations are included. Influence of elements of the configuration (canard, external fuel tank) on the flow about the wing is demonstrated. ESA

**N88-19196** Bristol Univ. (England). Dept. of Computer Science.
**APPLICATION OF THE MULTIGRID TECHNIQUE TO THE PRESSURE-CORRECTION EQUATION FOR THE SIMPLE ALGORITHM** c34
V. Pau and E. Lewis *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 121-142 (For primary document see N88-19187 11-64)
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It is shown that the multigrid method can be used to solve the pressure-correction equation in SIMPLE accurately and efficiently. Driven flow in a square cavity was analyzed. Using a 256 x 256 grid with R (restriction operator) = 1 and performing 22 global iterations, the multigrid method can give savings of 70 to 80 percent over standard relaxation methods, while producing a more accurate solution. ESA

**N88-19197** Erlangen-Nuremberg Univ. (West Germany). Lehrstuhl fuer Nachrichtentechnik.
**A SIGNAL PROCESSING APPROACH TO THE NUMERICAL SOLUTION OF PARABOLIC DIFFERENTIAL EQUATIONS**
Rudolf Rabenstein *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Method: Special Topics and Applications May 1987 p 145-154 (For primary document see N88-19187 11-64)
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An approach to solving partial differential equations which calculates samples of the exact solution from samples of the excitation, and initial and boundary values, rather than replacing a given differential equation by a difference equation through discretization of the derivatives is described. The spectral properties of the solution are taken into account by decomposing the solution into different frequency bands and calculating each band independently on a coarse grid. Thus, several grids with a fixed coarse mesh size operate in parallel, in contrast to the conventional multigrid methods, where only one grid with a variable mesh size is active at a time. The result is a flexible method, the inherent parallelism of which facilitates the efficient use of multi signal processors. ESA

**N88-19198** Technische Univ., Munich (West Germany).
**DISCRETIZATIONS FOR MULTIGRID METHODS**
Ulrich Ruede *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 155-172 (For primary document see N88-19187 11-64)
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Double discretization for smoothing and coarse grid correction in multigrid methods is described. The high frequency modes should be represented well for the smoothing, and discretizations representing the low frequency modes well should be used for the coarse grid correction. Parametrized discretizations are introduced, and suitable parameter values are found by local Fourier mode analysis. The resulting algorithm employs two different discretizations on each grid, except the coarsest. None of these discrete systems is solved. Instead they all only contribute a part to the final solution. Multigrid is then no iterative solver for a particular algebraic system, but is viewed as a finite, integrated algorithm for the solution of a differential equation. As two different iterations with different fixed points are applied on each grid, the concept of algebraic convergence is not applicable. Numerical experiments demonstrate the usefulness of the method. ESA

**N88-19199** Kernforschungsanlage, Juelich (West Germany).
**INCORPORATION OF MULTIGRID IN ACCELERATOR SOFTWARE** c61
Bernhard Steffen *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 173-188 (For primary document see N88-19187 11-64)
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The implementation of multigrid methods for eigenvalue calculations of Maxwell's equations used in practical accelerator design is described. The data structure as well as the structure of input and output is taken from older versions that do not use multigrid. For large problems the new methods are much faster than the old ones, though there is not sufficient data available to give details. ESA

**N88-19200** Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany).
**PERFORMANCE OF A MULTIGRID METHOD ON PARALLEL ARCHITECTURE** c61
Clemens-August Thole *In its* Multigrid Methods: Special Topics and Applications May 1987 p 189-204 Sponsored by the German Ministry of Research and Development (For primary document see N88-19187 11-64)
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The CalTech Hypercube (Mark 2) MIMD multiprocessor system is described. It consists of up to 128 individual small computers with own local memory, which are connected to each other by a special interconnection network. As an example for the implementation of numerical algorithms a multigrid method for the solution of the Laplace equation in 3D is considered. For this architecture the algorithm has to be parallelized and implemented in such a way that the overhead due to receiving results from the neighboring processors is small. It turns out that the speedup reached by this implementation is satisfactory. The time spent for the overhead is analyzed. As in the sequential case it turns out that the multigrid algorithm is much faster than fast Fourier transformation algorithms for solving this problem. ESA

**N88-19201** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**APPLICATIONS OF A MULTIGRID FINITE VOLUME METHOD WITH RUNGE-KUTTA TIME INTEGRATIONS FOR SOLVING THE EULER AND NAVIER-STOKES EQUATIONS** c34
B. Wagner, B. Leicher, and W. Schmidt *In* Gesellschaft fuer Mathematik und Datenverarbeitung mbH, Multigrid Methods: Special Topics and Applications May 1987 p 207-215 (For primary document see N88-19187 11-64)
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A numerical method for solving the compressible Euler and Navier-Stokes equations is described. Nonlinear time-dependent equations are numerically treated by a cell centered finite volume

scheme using Runge-Kutta time-stepping for timewise integration. For fast convergence to a steady state, a multigrid strategy, local time-stepping, implicit residual averaging, and enthalpy forcing are implemented. The finite volume formulation used is equivalent to a second order accurate central difference scheme in space needing artificial dissipation to suppress oscillations by odd/even decoupling. The time integration is decoupled from the space discretization by use of a class of explicit Runge-Kutta schemes. The numerical scheme and the formulation of the boundary conditions exhibit small and controllable numerical viscosity effects thus being suited to solution of the Navier-Stokes equations for compressible viscous flow at high Reynolds numbers. The multigrid procedure was applied to two-dimensional viscous flows about airfoil sections. ESA

**N88-19202*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**INSTITUTE FOR COMPUTATIONAL MECHANICS IN PROPULSION (ICOMP) Annual Report No. 2, 1987**
Mar. 1988 49 p
(NASA-TM-100790; ICOMP-88-1; E-3964; NAS 1.15:100790)
Avail: NTIS HC A03/MF A01 CSCL 12A

The Institute for Computational Mechanics in Propulsion (ICOMP) is operated jointly by Case Western Reserve University and the NASA Lewis Research Center in Cleveland, Ohio. The purpose of ICOMP is to develop techniques to improve problem-solving capabilities in all aspects of computational mechanics related to propulsion. Described are the activities of ICOMP during 1987. Author

**N88-18780*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A LOWER BOUND FOR THE DECODER ERROR PROBABILITY OF THE LINEAR MDS CODE**
K.-M. Cheung *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 43-49 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 12A

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N88-19203#** North Carolina Univ., Chapel Hill. Dept. of Statistics.
**ESTIMATION IN LINEAR MODELS WITH CENSORED DATA Technical Report, Aug. 1986 - Aug. 1987**
Helmut Schneider and Lisa Weissfeld (Michigan Univ., Ann Arbor.) 1986 6 p
(Contract F49620-85-C-0144)
(AD-A187209; AFOSR-87-1060TR) Avail: NTIS HC A02/MF A01 CSCL 12C

Three methods for linear regression with censored data are considered, that of Buckley and James (1979), a proposed simpler nonparametric method and a normal model for censored data. A new estimator for the variance of the error term in Buckley and James's procedure is proposed and simulations comparing the three methods are described. GRA

**N88-19204#** Texas Univ., Austin. Dept. of Computer Sciences.
**THEORY AND PRACTICE OF FAULT TOLERANCE IN DISTRIBUTED SYSTEMS Final Report, 15 Jun. 1985 - 14 Oct. 1986**
K. M. Chandy and J. Misra 30 Mar. 1987 12 p
(Grant AF-AFOSR-0252-85)
(AD-A187559; AFOSR-87-1462TR) Avail: NTIS HC A03/MF A01 CSCL 12E

Our work has concentrated on developing a unifying framework, under the name UNITY, for studying problem solving in parallel programming independent of specific architectural considerations. We have proposed a simple model of computation and a logic to reason about properties of such programs and have managed to study problems from a variety of problem areas. We have developed a number of transformations which are appropriate for implementations on a variety of architectures: sequential, asynchronous shared memory, distributed message passing, synchronous parallel with shared memory, systolic arrays, and VLSI chips. The diversity of the application areas and the architectures studied lends credence to our hypothesis that there is a UNITY to computer programming. GRA

**N88-19205#** Southern Methodist Univ., Dallas, Tex. Dept. of Statistical Science.
**POSITION FINDING AND TOLERANCES Final Report, 1 Jan. - 31 Dec. 1987**
Donald B. Owen 8 Dec. 1987 23 p
(Contract N00014-87-K-0180)
(AD-A187685) Avail: NTIS HC A03/MF A01 CSCL 17K

Duality between points and lines is examined, and the error distributions corresponding to various forms of duality are simulated. Several different least squares procedures for fitting of a line to several points are dualized to the fitting of a point to several lines. GRA

**N88-19206#** Florida State Univ., Tallahassee. Dept. of Statistics.
**DETERMINISTIC EQUIVALENT FOR A CONTINUOUS LINEAR-CONVEX STOCHASTIC CONTROL PROBLEM**
S. Sethi and M. I. Taksar 1 Sep. 1987 18 p
(Grants AF AFOSR-0278-87; NSF DMS-86-01510)
(AD-A187818; AFOSR-87-1480TR) Avail: NTIS HC A03/MF A01 CSCL 12C

The authors consider a finite horizon control model with additive input. There are two convex functions which describe the running and the terminal costs within the system. The cost of input is proportional to input and can take both positive and negative values. It is shown that there exists a deterministic control problem whose optimal cost is the same as the one in the stochastic control problem. The optimal policy in the stochastic problem consists of keeping the process as close to the optimal deterministic trajectory as possible. GRA

**N88-19207#** Naval Postgraduate School, Monterey, Calif.
**SOLUTION OF THE LLOYD-MAX QUANTIZER PARAMETERS BY THE METHOD OF SUCCESSIVE SUBSTITUTION Final Research Report, Oct. 1986 - Nov. 1987**
Paul H. Moose and Abdel-Aziz M. Al-Bassiouni 12 Nov. 1987 59 p
(AD-A187829; NPS-62-88-004) Avail: NTIS HC A04/MF A01 CSCL 12C

The method of successive substitution is shown applicable to solve for the classical minimum distortion quantizer parameters. The method is self converging and parameters can be calculated to any desired accuracy. The minimum distortion quantizer parameters, as well as parameters based on other criterion such as quantizers for signal detection, minimum risk quantizers and quantizers for LMMS estimation can be solved by Max's trial and error technique. There are also many other approximation methods to calculate the quantizer parameters. This report applies the method of successive substitution and its modifications to solve for the Lloyd-Max quantizer parameters. It is more accurate and computationally more efficient than the previously reported methods. It is shown to easily generate 7 bit (128 level) optimum quantization. The Lloyd-Max minimum mean square distortion quantizer problem deals with transforming a random variable X of differentiable probability density function f(x) into the N-level discrete random variable Y. GRA

**N88-19208#** Clemson Univ., S.C. Dept. of Mathematical Sciences.
**GENERATING THE STATES OF A PROBABILISTIC SYSTEM**
D. R. Shier, E. J. Valvo, and R. E. Jamison Dec. 1986 28 p
(Grant AF-AFOSR-0154-84)

(AD-A187896; TR-529; AFOSR-87-1606TR) Avail: NTIS HC A03/MF A01 CSCL 12C

An important task in the evaluation of a communication or distribution system is assessing the performance of the system, when its components are subject to random failure. One approach for approximating various such performance measures is to generate a relatively small set of states of the system that covers in probability a large portion of the probabilistic system in order of nonincreasing probability. Rather interestingly, there is an elegant algebraic structure (a lattice) underlying this problem, and this structure can be exploited to produce a relatively effective algorithm for generating in order the states of the given system. In addition, the worst-case computational complexity of the algorithm is shown to be related to a certain algebraic invariant of the lattice. GRA

**N88-19209#** Stanford Univ., Calif. Dept. of Statistics.
**JOINT MOMENTS OF THE MAXIMUM IN A CRITICAL BRANCHING PROCESS**
Howard Weiner 15 Oct. 1987 10 p
(Contract N00014-86-K-0156)
(AD-A188157; TR-397) Avail: NTIS HC A02/MF A01 CSCL 12C

The asymptotic order of magnitude of the joint moments of the maxima in a critical Galton Watson process are given. GRA

**N88-19210** Politecnico di Milano (Italy). Dipt. di Elettronica.
**STOCHASTIC HEURISTICS IN NETWORK DESIGN: PARAMETER TUNING AND PERFORMANCE EVALUATION**
P. M. Camerini, A. Colorni, F. Maffioli, and E. G. Morselli 1987 50 p
(Rept-87-017; ETN-88-91653) Avail: Issuing Activity

General purpose stochastic heuristics were applied to NP-hard combinatorial optimization problems arising in the general context of network design, namely location, Steiner tree, and communication spanning tree. To each problem, three stochastic algorithms were applied: sampling-and-clustering, simulated annealing, and Bayesian testing. The algorithms enhance a global (i.e., generation), a local (i.e., search), and a test (i.e., stopping) phase, respectively, hence suggesting the use of a more general heuristic, combining their features. For each method, an individual analysis was designed, in order to determine the most suitable values for the main input parameters which control the algorithm behavior. Statistical techniques suggested by Pareto dominance concepts play a key role in this analysis, and are also shown to allow a comparison of the three methods. ESA

**N88-19211** New South Wales Univ., Sydney (Australia).
**EXTREMA OF GAUSSIAN PROCESS BY SIMULATION Abstract Only Ph.D. Thesis**
Shahaboddin Ghahreman Oct. 1986 163 p
Avail: Issuing Activity

Problems related to level-crossings by stochastic processes are introduced and a number of papers related to this field are reviewed. Some exact mathematical results which are either applicable in asymptotic cases or refer to particular processes are given. Various methods which so far were suggested for stimulating stochastic processes are introduced. A simple practical procedure for approximating a stationary Gaussian process over a finite interval by a trigonometric polynomial with predetermined error is described. The approximation is then used to calculate the distribution of the maximum, using an efficient way of calculating a multivariate probability distribution by means of a Monte Carlo method with a control variable which reduces the variance. The probability distribution of the maximum of a narrow band response to random excitation is an important parameter in the design of many engineering systems. The response is first represented by an optimum trigonometric polynomial of comparatively small order and then this is used to simulate the process and obtain the distribution of its maximum. The method of finite trigonometric approximation and the Karhunen-Loeve expansion are used to derive a method for stimulating a Slepian model process and, as an example, the distribution function of its excursion-time above a given level is obtained. The non-stationary solution of a linear oscillator is treated and a method for its simulation is derived. Author

**N88-19212#** Sandia National Labs., Albuquerque, N. Mex.
**THE SAS (STATISTICAL ANALYSIS SYSTEM) BY FORMS: PUTTING STATISTICAL POWER INTO THE HANDS OF AN END-USER**
Jonathan W. Lee Sep. 1987 7 p Presented at the SAS Users Group International (SUGI-13), Orlando, Fla., 27 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002217; SAND-87-2356C; CONF-880321-2) Avail: NTIS HC A02/MF A01

Statistical Analysis System (SAS) software provides a high level programming tool for data analysis, presumably with little effort. However, the flexibility of the language and its multitudinous options can both intimidate and confuse a casual user of SAS. How can the full power of SAS be integrated in such a way that end-users with limited training can perform their own analyses without sacrificing flexibility. This paper describes how SAS has been integrated into a menu-driven system which can be adapted to an extensible set of SAS procedures in a dynamic data environment. The system operates under VMS and utilizes the DIGITAL FMS Forms Management System. DOE

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

**N88-19213#** University Coll., Dublin (Ireland). Dept. of Statistics.
**OPTIMAL ARRANGEMENT OF COMPONENTS VIA PAIRWISE REARRANGEMENTS**
Philip J. Boland, Frank Proschan, and Y. L. Tong (Georgia Inst. of Tech., Atlanta.) Oct. 1987 13 p
(Contract F49620-85-C-0007; Grant NSF DMS-85-02346)
(AD-A187633; AFOSR-87-1600TR) Avail: NTIS HC A03/MF A01 CSCL 12C

The authors introduce the notion of comparison of the criticality of two nodes in a coherent system, and develop a monotonicity property of the reliability function under component pairwise rearrangement. They use this property to find the optimal component arrangement. Worked examples illustrate the methods proposed. GRA

**N88-19214#** Naval Postgraduate School, Monterey, Calif.
**A COMPUTER GRAPHICS SIMULATION OF THE ENDGAME IN AIRCRAFT COMBAT SURVIVABILITY M.S. Thesis**
Yeong M. Lee Dec. 1987 78 p
(AD-A187826) Avail: NTIS HC A05/MF A01 CSCL 15F

A comprehensive computer graphics program was designed for students of the Naval Postgraduate School to assess the vulnerability of air targets to externally detonating missile warheads. This computer simulation program was written in the C language and runs on the IBM PC/AT or compatible. It illustrates the endgame phase of a typical air defense scenario and provides the students the capability to comprehend the dynamic situation. GRA

**N88-19215*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**RECURSIVE INVERSION OF EXTERNALLY DEFINED LINEAR SYSTEMS**
Ralph E. Bach, Jr. and Yoram Baram Mar. 1988 13 p
(NASA-TM-100070; A-88093; NAS 1.15:100070) Avail: NTIS HC A03/MF A01 CSCL 12B

The approximate inversion of an internally unknown linear system, given by its impulse response sequence, by an inverse system having a finite impulse response, is considered. The recursive least squares procedure is shown to have an exact initialization, based on the triangular Toeplitz structure of the matrix

involved. The proposed approach also suggests solutions to the problems of system identification and compensation. Author

**N88-18794*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE DESIGN AND IMPLEMENTATION OF THE TECHNICAL FACILITIES CONTROLLER (TFC) FOR THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX**
D. A. Killian, F. J. Menninger, T. Gorman, and P. Glenn *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 175-183 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 12B

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

**N88-19216#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**THE CONSTRUCTION OF A PEDAGOGY TO PROMOTE MEANINGFUL LEARNING OF STRATEGIES AND TACTICS FOR SOLVING PROBLEMS OF ELEMENTARY COMBINATORICS M.S. Thesis**
Pedro Rodriguez-Pascual Sep. 1987 166 p
(AD-A187928; AFIT/GEM/ENC/87S-26) Avail: NTIS HC A08/MF A01 CSCL 12B

The purpose of this study was to construct a new methodology for teaching combinatorics based on Doctor Ausubel's theory about meaningful learning. The key idea Ausubel's theory is that if learning has to be meaningful, then the learner has to have subsuming or anchoring concepts in his cognitive structure. Combinatorics has typically been one of those subjects the students have more difficulty in understanding. This phenomenon happens because previous presentations of combinatorics leave a great deal to be desired pedagogically, and do not place enough emphasis on visualization. As a result, students use to learn course materials in a rote manner, and find little motivation for such learning activities. A prescription has been found to remedy such pathology. A conceptual map, rather than typically organized hierarchy of concepts, has been developed. The conceptual map interrelates the main and subordinate concepts in a cyclical manner, in a repetitive way, in a gradual and smooth progress, to enable the reader to assimilate ideas meaningfully. GRA

**N88-19217** New South Wales Univ., Kensington (Australia).
**IRREDUCIBLE TENSOR OPERATORS AND MULTIPLE-QUANTUM NMR Abstract Only. Ph.D. Thesis**
Wayne Douglas Hutchison Feb. 1987 168 p
Avail: Issuing Activity

A concise, and illuminating, mathematical description of multiple quantum nuclear magnetic resonance (MQNMR) experiments, on essentially isolated (noncoupled) nuclei was sought. The treatment used is based on irreducible tensor operators, which form an orthonormal basis set. Such operators can be used to detail the state of the nuclear ensemble during every stage, preparation, evolution, and detection of a MQNMR experiment. The properties of irreducible tensor operators are discussed. In particular, symmetric and antisymmetric combinations of tensor operators are introduced, to reflect the Hermitian nature of the nuclear Hamiltonian and density matrix. The creation of multipolar nuclear states using hard, nonselective RF pulses, is detailed for spin I = 1, 3/2, 2, and 5/2 nuclei, subject to an axially symmetric quadrupole interaction. Experimental results, verifying the production of a triple quantum NMR state, for the I = 3/2 Na-23 in a single crystal of NaIO4 are presented and discussed. The treatment of MQNMR experiments is extended to the low temperature regime where the initial density matrix includes Fano statistical errors other than rank one. The effect of a more general quadrupole Hamiltonian on MQNMR experiments is considered for spins I = 1 and 3/2. It is shown that double quantum states evolve to five longitudinal NMR signal, oscillating at twice the Larmor frequency, in the presence of an asymmetry term. Finally, results are presented for the evolution of I = 1 and 3/2 nuclear systems under the action of soft or intermediate strength RF pulses. Author

**N88-18783*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**A COMPARISON OF VLSI ARCHITECTURES FOR TIME AND TRANSFORM DOMAIN DECODING OF REED-SOLOMON CODES**
I. S. Hsu, T. K. Truong, L. J. Deutsch, E. H. Satorius, and I. S. Reed (University of Southern California, Los Angeles.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 63-81 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 12E

# 70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

**N88-18776*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE JPL TRAPPED MERCURY ION FREQUENCY STANDARD**
J. D. Prestage, G. J. Dick, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 13-19 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 20C

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

**N88-19218*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**ACOUSTIC MEASUREMENTS FROM A ROTOR BLADE-VORTEX INTERACTION NOISE EXPERIMENT IN THE GERMAN-DUTCH WIND TUNNEL (DNW)**
Ruth M. Martin, W. R. Splettstoesser, J. W. Elliott, and K.-J. Schultz (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, West Germany ) Mar. 1988 183 p
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-4024; L-16368; NAS 1.15:4024; AVSCOM-TR-87-B-4)
Avail: NTIS HC A09/MF A01 CSCL 20A

Acoustic data are presented from a 40 percent scale model of the 4-bladed BO-105 helicopter main rotor, measured in the large European aeroacoustic wind tunnel, the DNW. Rotor blade-vortex interaction (BVI) noise data in the low speed flight range were acquired using a traversing in-flow microphone array. The experimental apparatus, testing procedures, calibration results, and experimental objectives are fully described. A large representative set of averaged acoustic signals is presented. Author

**N88-19219#** Computer Sciences Corp., San Diego, Calif.
**AN APPLICATION OF DIMENSIONLESS EIGENVALUES TO UNDERWATER ACOUSTIC DUCTS Final Report, Oct. 1983 - Sep. 1984**
F. Hosmer, D. F. Gordon, and M. A. Pedersen Jul. 1987 64 p
(Contract N66001-85-D-0138; DA Proj. RR0-3103)
(AD-A188167; NOSC-TD-1127) Avail: NTIS HC A04/MF A01 CSCL 20A

The major objective of this article is to examine eigenvalue equations expressed in terms of dimensionless variables. Our application is to underwater acoustic ducts for which the square of the index of refraction is piecewise linear. For this case the eigenvalue equation involves the Airy functions A1, B1, A1, and B1 for various arguments. We consider two related approaches to the eigenvalue problem. The first approach is the usual one, while the second approach is that of this article. The first approach is to determine the eigenvalues, i.e., the mode phase velocity, as a

function of frequency and the profile parameters. Given a sound speed profile, one iterates the eigenvalue equation to determine the mode phase velocity as a function of frequency. This approach is useful when treating profiles with a large number of layers. GRA

**N88-19220*#** Astron Research and Engineering, Santa Monica, Calif.
**ANALYSIS OF IN-FLIGHT ACOUSTIC DATA FOR A TWIN-ENGINED TURBOPROP AIRPLANE Final Report**
J. F. Wilby and E. G. Wilby Jan. 1988 122 p
(NASA Order L-10241-C)
(NASA-CR-178389; NAS 1.26:178389; ASTRON-7107-01) Avail: NTIS HC A06/MF A01 CSCL 20A

Acoustic measurements were made on the exterior and interior of a general aviation turboprop airplane during four flight tests. The test conditions were carefully controlled and repeated for each flight in order to determine data variability. For the first three flights the cabin was untreated and for the fourth flight the fuselage was treated with glass fiber batts. On the exterior, measured propeller harmonic sound pressure levels showed typical standard deviations of +1.4 dB, -2.3 dB, and turbulent boundary layer pressure levels, +1.2 dB, -1.6. Propeller harmonic levels in the cabin showed greater variability, with typical standard deviations of +2.0 dB, -4.2 dB. When interior sound pressure levels from different flights with different cabin treatments were used to evaluate insertion loss, the standard deviations were typically plus or minus 6.5 dB. This is due in part to the variability of the sound pressure level measurements, but probably is also influenced by changes in the model characteristics of the cabin. Recommendations are made for the planning and performance of future flight tests to measure interior noise of propeller-driven aircraft, either high-speed advanced turboprop or general aviation propellers. Author

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

**N88-19221#** Defence Research Establishment, Ottawa. (Ontario).
**MEASUREMENT OF THE GAMMA-RAY RESPONSE OF SOME COMMERCIAL SILICON DETECTORS**
S. McGowan Jun. 1987 30 p
(AD-A187431; DREO-R-958) Avail: NTIS HC A03/MF A01 CSCL 18D

This report gives the results of measurements of the response of some commercial photodiodes and particle detectors to monoenergetic gamma-ray sources. The absolute response and the response, as a function of photon energy, detector thickness and discriminator level, were investigated and are shown to be in general agreement with earlier calculations. It is concluded that, with appropriate photon filtration, the small photodiodes tested would be suitable for the relatively high dose-rate measurements of primary interest for military applications, although their thickness is greater than the thickness for best energy response. GRA

**N88-19222#** Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
**CHARGE EXCHANGE IN LOW ENERGY (keV) AND HYPERTHERMAL ENERGY (10-100 eV) ION SCATTERING Final Report, 1 Apr. 1986 - 15 Nov. 1987**
Barbara H. Cooper 10 Dec. 1987 14 p
(Grant AF-AFOSR-0086-86)
(AD-A187643; AFOSR-87-1926TR) Avail: NTIS HC A03/MF A01 CSCL 07D

The overall research program described in this report is to investigate the interaction of low (keV) and hyperthermal (10 to 100 eV) ions with clean and adsorbate-covered metal surfaces; in particular, ion-surface charge exchange processes. We report on the operation of the UHV scattering apparatus for the ion scattering measurements, ongoing development and upgrade of the apparatus, the use of two ion scattering simulations which together cover the entire energy range of interest, the further development of these simulations, and most importantly, the ongoing experiments to determine charge transfer probabilities. The data we present in this report are representative of the scattering spectra we measure. Completed analysis of these and similar spectra will be presented in forthcoming papers. To date, we have measured spectra for Li+, Na+, K+, He+, Ne+, and Ar+ beams, ranging in energy from 50 eV to 4 keV, scattered from the 001 and 1 to 10 azimuths of Cu(110). Important features of these spectra have been identified with the scattering simulations. GRA

**N88-19223#** Oregon Univ., Eugene.
**THEORY OF TWO-PHOTON EMISSION FROM ATOMIC INNER SHELLS Report, 15 Jan. 1987 - 14 Jan. 1988**
Dong-Sheng Guo Jul. 1987 17 p
(Grant AF-AFOSR-0026-87)
(AD-A187742; AFOSR-87-1424TR) Avail: NTIS HC A03/MF A01 CSCL 20E

From quantum electrodynamics it is proved that two-photon emission in transitions between atomic inner shells can be treated in lowest order approximation in the single particle model. Taking many body effects into account to show that, in the reduced single-particle model, the Pauli exclusion principle does not prohibit summing over all possible intermediate states, including core states. Some transition rate formulas are presented that are useful for numerical calculations. GRA

**N88-19224#** State Univ. of New York, Buffalo. Dept. of Chemistry.
**CLUSTERS: LINK BETWEEN MOLECULES AND SOLIDS**
Daniel A. Jelski and Thomas F. George Nov. 1987 35 p
(Contracts N00014-86-C-0043; F49620-86-C-0009; Grant NSF CHE-86-20274)
(AD-A188170; UBUFFALO/DC/87/TR-58) Avail: NTIS HC A03/MF A01 CSCL 20E

The physics and chemistry of clusters is discussed. First, clusters are compared with molecules, on the one hand, and then with solids on the other. It is found that clusters are an intermediate state, and therefore of special interest. The Huckel model is elucidated since this is the simplest of possible semi-empirical methods, and since it is readily applied to clusters. Two kinds of clusters are discussed in greater detail: alkali-metal clusters, because they are the obvious candidate for application of the Huckel model, and Buckminsterfullerene, which is a C60 cluster arranged in a soccer ball geometry. GRA

**N88-19225*#** Minnesota Univ., Minneapolis. Dept. of Chemistry.
**A SIMPLE INTERPRETATION OF THE Fe2(-) PHOTOELECTRON SPECTRUM**
Doreen G. Leopold, Jan Almlof, W. C. Lineberger, and Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.) [1987] 15 p Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, Colo. and NBS, Boulder, Colo.
(Contract NCC2-371)
(NASA-CR-182553; NAS 1.26:182553) Avail: NTIS HC A03/MF A01 CSCL 08G

The photoelectron spectrum of Fe2(-) can be simply interpreted in terms of electron detachment from the mildly bonding 4s sigma sup * sub u orbital of a (4s sigma sub s)(sup 2) (4s sigma sup * sub u)(sup 2) (3d)(sup 13) anion. This interpretation implies a (4s sigma sub g)(sup 2) (4s sigma sup * sub u)(sup1) (3d)(sup13) configuration for the ground state of Fe2, correlating with one ground state (4s2 3d6) and one excited state (4s1 3d7) Fe atom. A comparison of the bond length and vibrational frequency of Fe2 to values for transition metal dimers containing single 4s-4s bonds is suggestive of 3d-3d bonding in this molecule. The results of preliminary full-valence configuration interaction calculations provide stron support for the proposed Fe2 and Fe2(-) configurations. Author

**N88-19226*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**CORE-CORE AND CORE-VALENCE CORRELATION**
Charles W. Bauschlicher, Jr., Stephen R. Langhoff, and Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.) [1988] 20 p
(Contract NCC2-371)
(NASA-CR-182552; NAS 1.26:182552) Avail: NTIS HC A03/MF A01 CSCL 20H

The effect of (1s) core correlation on properties and energy separations was analyzed using full configuration-interaction (FCI) calculations. The Be 1 S - 1 P, the C 3 P - 5 S and CH+ 1 Sigma + or - 1 Pi separations, and CH+ spectroscopic constants, dipole moment and 1 Sigma + - 1 Pi transition dipole moment were studied. The results of the FCI calculations are compared to those obtained using approximate methods. In addition, the generation of atomic natural orbital (ANO) basis sets, as a method for contracting a primitive basis set for both valence and core correlation, is discussed. When both core-core and core-valence correlation are included in the calculation, no suitable truncated CI approach consistently reproduces the FCI, and contraction of the basis set is very difficult. If the (nearly constant) core-core correlation is eliminated, and only the core-valence correlation is included, CASSCF/MRCI approached reproduce the FCI results and basis set contraction is significantly easier. Author

**N88-19227#** Lawrence Livermore National Lab., Calif.
**EMISSION OF GAMMA RAYS FROM VARIOUS MATERIALS PULSED WITH 14-MeV NEUTRONS**
E. Goldberg, L. F. Hansen, R. J. Howerton, T. T. Komoto, and B. A. Pohl Oct. 1987 8 p Presented at the Nuclear Explosives Design Physics Conference, Los Alamos, N. Mex., 19 Oct. 1987
(Contract W-7405-eng-48)
(DE88-003837; UCRL-97539; CONF-8710192-2) Avail: NTIS HC A02/MF A01

We have performed a number of experiments to investigate the leakage of gamma rays from spheres of selected materials pulsed centrally with 14-MeV neutrons. Such spectral information may be carefully compared to calculational results to validate the transport models, particularly the nuclear cross section data base. In the present case, the TART code and SANDYL codes are used to explicitly calculate the observable, the recoil electron spectrum. The materials studied were H sub 2 O, (6) $^{6}$LiD, Be, C, (14) N, CF sub 2, Al, Si, Ti, Fe, Cu, Ta, W, Au, Pb, Th, and (238) U. Generally, agreement was good between experiment and calculation. However, for some, the calculations significantly underestimated or overestimated experiment. For oxygen (i.e., H sub 2 O) the ENDL cross section set led to a sizeable calculational overestimate. Re-examination led to a large improvement. For tungsten, the calculated output was approx. 30 percent below experiment. A re-evaluation led to closer agreement. DOE

**N88-19228#** Sandia National Labs., Albuquerque, N. Mex.
**ATOMISTIC SIMULATION OF LOW-ENERGY BEAM DEPOSITION**
B. W. Dodson 1987 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-004344; SAND-87-1486C; CONF-871124-20) Avail: NTIS HC A02/MF A01

Low-energy (50 eV) homoepitaxial beam deposition of silicon is simulated using many-body silicon potentials and molecular dynamics techniques. Results are presented for the case of a 50 eV neutral silicon beam incident on the (2 x 1) dimer reconstructed Si(100) surface. The beam is aligned along (110) symmetry directions, which are the most natural channeling directions in the silicon lattice. Roughly 10 percent of the incident beam atoms are scattered from the surface with a small fraction of their initial energy. About half of the incident atoms penetrate the lattice, but scatter strongly and come to rest within 10 to 15 A of the surface. The remainder are steered accurately into the bulk (110) channels, where they penetrate some 30 to 100 A into the lattice. Those atoms which do not undergo bulk channeling cause considerable lattice damage to the near-surface (depth greater than or equal to 10 A) region. DOE

**N88-19229#** Lawrence Livermore National Lab., Calif.
**RESONANTLY-ENHANCED, FOUR-PHOTON IONIZATION OF KRYPTON AT LASER INTENSITIES EXCEEDING 10(12) W/SQ cm**
M. D. Perry, O. L. Landen, and E. M. Campbell Dec. 1987 12 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-48)
(DE88-005038; UCRL-97897; CONF-880110-15) Avail: NTIS HC A03/MF A01

The yield of singly- and multiply- charged ions of krypton and xenon is presented as a function of laser intensity and frequency. The measurements were performed using the second harmonic output of a well-characterized, tunable picosecond dye laser in the range 285 to 310 nm at laser intensities from 1 x 10 to the 12th power to 10 to the 14th power W/square cm. Enhancement of the Kr (+) yield by two orders of magnitude by three-photon resonant, four-photon ionization is observed in the vicinity of the 4d prime (5/2) sub 3 and the 4d (3/2) sub 1 intermediate states. A model incorporating line shifts and widths scaling linearly with intensity is in good agreement with the experimental results. DOE

**N88-19230#** Sandia National Labs., Livermore, Calif.
**ATOMIC-SCALE SIMULATION IN MATERIALS SCIENCE**
M. Baskes, M. Daw, S. Foiles, and B. Dodson Jan. 1988 35 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DR-00789)
(DE88-005204; SAND-87-2725J) Avail: NTIS HC A03/MF A01

State of the art techniques of atomistic simulation are discussed. Numerous examples of application to semiconductors and metals are presented. DOE

**N88-19231#** Los Alamos National Lab., N. Mex.
**PION NUCLEUS SINGLE CHARGE EXCHANGE REACTIONS ABOVE THE DELTA(1232) RESONANCE Ph.D. Thesis**
Sayed H. Rokni Jun. 1987 216 p
(Contract W-7405-eng-36)
(LA-11004-T) Avail: NTIS HC A10/MF A01

Forward-angle differential cross-sections for the (pi(+), pi(0)) reaction leading to the Isobaric Analog State in the residual nuclei at 300, 425, 500 and 550 MeV have been measured. Targets ranged in mass from Li-7 to Pb-208. A description of the experimental setup and the analysis is presented. The O(0) cross sections are found to rise markedly between 300 and 425 MeV, contrary to the extrapolation from the lower energy data and to the behavior of the free pion-nucleon single charge exchange process. The angular distributions are sharply forward peaked. Systematics of the data indicate increased volume penetration with increasing pion beam energy. The cross-sections are compared with the results of Glauber model calculcations indicating the significance of higher order processes even at these energies. Author

**N88-19232#** Los Alamos National Lab., N. Mex.
**PION ELASTIC AND INELASTIC SCATTERING NEAR N=28 Ph.D. Thesis - Texas, Univ., Austin**
David Sterling Oakley (Texas Univ., Austin.) Apr. 1987 225 p
(LA-10968-T; UC-34) Avail: NTIS HC A10/MF A01

Differential cross sections were measured for pion elastic and inelastic scattering from Ti-48, Ti-50, V-51, Cr-52, Fe-54, and Fe-56 at T(pi) = 180 MeV. Elastic scattering data were analyzed using a standard Kisslinger potential while inelastic scattering data were analyzed using distorted-wave and coupled-channel impulse-approximation calculations with collective-model and microscopic transition densities. The resulting angular distributions are explained and anomalies discussed. The ground state neutron density parameters and matrix elements are also extracted and

compared with other experiments and all pion/anti-pion differences are investigated. M.G.

**N88-19233#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**NUCLEON RESONANCES AND NUCLEI: EXPERIMENTAL ASPECTS**
Volker Burkert 1987 28 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-025) Avail: NTIS HC A03/MF A01

An overview of the experimental status of nucleon resonance transition form factors is given. Recent photo- and electroproduction experiments from nuclei in the resonance region are discussed, and prospects for measurements at future CW electron accelerators are briefly addressed. Author

**N88-19234#** Pittsburgh Univ., Pa. Dept. of Physics and Astronomy.
**EXPERIMENTAL ELEMENTARY PARTICLE PHYSICS AT THE UNIVERSITY OF PITTSBURGH Progress Report, 1 Apr. 1987 - 31 Mar. 1988**
W. E. Cleland, D. D. Coon, E. Engels, Jr., P. F. Shepard, and J. A. Thompson Dec. 1987 108 p
(Contract DE-AC02-80ER-10667)
(DE88-003542; DOE/ER-10667/T3) Avail: NTIS HC A06/MF A01

This paper discusses research activity at the University of Pittsburgh in experimental elementary particle physics. The three main tasks included are: Study of lepton production at the SPS and study of large P(sub T) direct photon production at the ISR; Direct photon production at the Fermi Tevatron; and Search for fractional charge particles in semiconductors. DOE

**N88-19235#** Syracuse Univ., N. Y.
**MEDIUM HIGH ENERGY PHYSICS AT SYRACUSE UNIVERSITY Technical Progress Report**
1987 37 p
(Contract DE-FG02-84ER-40146)
(DE88-003670; DOE/ER-40146/T2) Avail: NTIS HC A03/MF A01

The main effort of the group has been to perform an experiment at the MIT-Bates Linear Accelerator Center to measure the spin-dependence of elastic scattering from carbon. Polarized electrons were injected into the Bates Linac at intensities approaching the design value with acceptable lifetimes. A preliminary measurement also has been made of the parity-violating asymmetry with a sensitivity a few times that of expected effect. We are proceeding to improve this result by at least an order of magnitude. We are also a member of the collaboration which will measure the tensor polarization of deuterons scattered by electrons. Preliminary running of this experiment occurred this past year. DOE

**N88-19236#** Massachusetts Univ., Amherst.
**NUCLEAR STRUCTURE STUDIES BY THE SCATTERING OF MEDIUM-ENERGY ELECTRONS Progress Report, 1 Sep. 1986 - 30 Jun. 1987**
G. A. Teterson, R. S. Hicks, J. F. Dubach, and R. A. Miskimen Jun. 1987 49 p
(Contract DE-AC02-76ER-02853)
(DE88-003803; DOE/ER-02853/33) Avail: NTIS HC A03/MF A01

This paper discusses the experimental electron scattering studies at SLAC and Bates Accelerator Center. Some theoretical work on nucleon-nucleon interactions, electromagnetic interactions, weak interactions and nuclear structure are also discussed. DOE

**N88-19237#** Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
**ATOMISTIC STUDIES OF THE STRUCTURE AND PROPERTIES OF GRAIN BOUNDARIES WITH SUBSTITUTIONAL IMPURITIES Final Report**
V. Vitek Nov. 1987 9 p
(Contract DE-FG02-84ER-45129)
(DE88-004161; DOE/ER-45129/3) Avail: NTIS HC A02/MF A01

A number of atomistic computer simulation studies were carried out with the aim to understand the most important features of the grain boundary structures in pure metals, disordered alloys in which segregation takes place and also in some ordered alloys. All the grain boundary studies carried out in this project utilized empirically constructed pair-potentials to describe interatomic forces. We have, therefore, concentrated on those structural properties which are general, common to boundaries in various metals and alloys. DOE

**N88-19238#** Oregon Univ., Eugene.
**THEORY OF ELEMENTARY PARTICLE STUDIES IN WEAK ITERATION AND GRAND UNIFICATION AND STUDIES IN ACCELERATOR DESIGN Annual Report**
N. G. Deshpande 1987 22 p
(Contract DE-FG06-85ER-40224)
(DE88-004261; DOE/ER-40224/43) Avail: NTIS HC A03/MF A01

This paper discusses the work done in high energy physics at the University of Oregon over the past year. Some of the topics discussed are: string phenomenology, horizontal symmetry, heavy quark decays, neutrino counting and new quarks and leptons, treatment of heavy particles and w-bosons as constituents of hadrons, higher twist corrections to heavy particle production, factorization in the Drell-Yan process, jets and compositeness at the SSC, minimum-bias physics in hadronic collisions, and quark-gluon plasma. DOE

**N88-19239#** Los Alamos National Lab., N. Mex.
**NUCLEAR TRANSITIONS INDUCED BY ATOMIC EXCITATIONS**
P. L. Dyer, J. A. Bounds, R. C. Haight, and T. S. Luk 1988 7 p Presented at the Innovative Science and Technology Symposium, Los Angeles, Calif., 13 Jan. 1988 Prepared in cooperation with Illinois Univ., Urbana
(Contract W-7405-eng-36)
(DE88-004311; LA-UR-87-4102; CONF-880141-2) Avail: NTIS HC A02/MF A01

In the two-step pumping scheme for a gamma-ray laser, an essential step is that of exciting the nucleus from a long-lived storage isomer to a nearby short-lived state that then decays to the upper lasing level. An experiment is in progress to induce this transfer by first exciting the atomic electrons with UV photons. The incident photons couple well to the electrons, which then couple via a virtual photon to the nucleus. As a test case, excitation of the U-235 nucleus is being sought, using a high-brightness UV laser. The excited nuclear state, having a 26-minute half-life, decays by internal conversion, resulting in emission of an atomic electron. A pulsed infrared laser produces an atomic beam of U-235 which is then bombarded by the UV laser beam. Ions are collected, and conversion electrons are detected by a channel electron multiplier. In preliminary experiments, an upper limit of 7 x 10 to the -5 has been obtained for the probability of exciting a U-235 atom in the UV beam for one picosecond at an intensity of about 10 to the 15th power W/sq cm. Experiments with higher sensitivities and at higher UV beam intensities are under way. DOE

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

**N88-19240#** Lawrence Livermore National Lab., Calif.
**GAS-COOLED REACTOR POWER SYSTEMS FOR SPACE**
C. E. Walter Jan. 1987 32 p Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12 Jan.

1987
(Contract W-7405-eng-48)
(DE88-005220; UCRL-95047-Rev-2; CONF-870102-1-Rev-2)
Avail: NTIS HC A03/MF A01

Efficiency and mass characteristics for four gas-cooled reactor power system configurations in the 2- to 20-MWe power range are modeled. The configurations use direct and indirect Brayton cycles with and without regeneration in the power conversion loop. The prismatic ceramic core of the reactor consists of several thousand pencil-shaped tubes made from a homogeneous mixture of moderator and fuel. The heat rejection system is found to be the major contributor to system mass, particularly at high power levels. A direct, regenerated Brayton cycle with helium working fluid permits high efficiency and low specific mass for a 10-MWe system. DOE

**N88-19241#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**THE INJECTOR FOR THE CEBAF CW SUPERCONDUCTING LINAC**
W. Diamond 1987 6 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-011) Avail: NTIS HC A02/MF A01

The CEBAF CW superconducting linac contains two 0.5 GeV linacs connected by recirculator arcs. The electron beam from the injector must be sufficiently relativistic to match a 1 GeV recirculated beam in the first linac. An injector is described that produces a high quality electron beam with transverse emittance of zeta pi mm-mrad and longitudinal emittance of zeta 15 pi keV-degrees. A subharmonic chopper and three independently adjustable chopping slits are used to differentially load successive bunches. A room temperature linac is used to accelerate the electron beam from 100 keV to about 0.6 MeV. Eighteen five-cell superconducting cavities are used to increase the energy to approximately 45 MeV for matching with the rest of the linac. Author

**N88-19242#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**PERTURBATION EFFECTS IN THE CEBAF BEAM TRANSPORT SYSTEM**
D. R. Douglas and R. C. York 1987 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-010) Avail: NTIS HC A02/MF A01

The CEBAF accelerator design is a recirculating, superconducting, CW, electron linac producing beams with energies of 0.5 to 4.0 GeV. The lattice design of this machine is described elsewhere. Here, the machine chromatic scheme, the anticipated machine performance in the presence of synchrotron radiation excitation, optical perturbations such as misalignments, mispowerings, and magnet inhomogeneities, and errors in the extraction process are discussed. Author

**N88-19243#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**SINGLE NUCLEON COINCIDENCE CROSS SECTIONS IN A RELATIVISTIC MEAN FIELD THEORY**
S. J. Pollock [1987] 31 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-016) Avail: NTIS HC A03/MF A01

Single nucleon emission cross sections in finite nuclear matter are computed within the context of a consistent, relativistic field theory with a conserved electromagnetic current. Special emphasis is placed on calculation of the 4 nuclear response functions, the full differential coincidence cross sections, the integrated singles cross section, and the Coulomb sum rule. Experimental inelastic cross sections can be used to fit the two free parameters in the theory for specific nuclei. Also, the kinematics required to measure the out of plane response functions are analyzed. Author

**N88-19244#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**HIGH ENERGY POLARIZED ELECTRON BEAMS**
Robert Rossmanith [1987] 18 p Presented at University of Trieste Lectures, Trieste, Italy, May 1987
(Contract DE-AC05-84ER-40150)
(CEBAF-R-87-002) Avail: NTIS HC A03/MF A01

In nearly all high energy electron storage rings the effect of beam polarization by synchrotron radiation has been measured. The buildup time for polarization in storage rings is of the order of 10 to the 6th to 10 to the 7th revolutions; the spins must remain aligned over this time in order to avoid depolarization. Even extremely small spin deviations per revolution can add up and cause depolarization. The injection and the acceleration of polarized electrons in linacs is much easier. Although some improvements are still necessary, reliable polarized electron sources with sufficiently high intensity and polarization are available. With the linac-type machines SLC at Stanford and CEBAF in Virginia, experiments with polarized electrons will be possible. Author

**N88-19245#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**EXPERIMENTAL ASPECTS OF HYPERNUCLEAR PHYSICS AT CEBAF**
Bernhard A. Mecking [1986] 26 p
(Contract DE-AC05-84ER-40150)
(CEBAF-R-86-013) Avail: NTIS HC A03/MF A01

The general features of the electromagnetic excitation of hypernuclei are outlined. Experimental aspects of investigating these reactions at CEBAF are discussed. Two specific experimental set-ups are compared. Author

**N88-19246#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**ADVANCED NONLINEAR THEORY: LONG-TERM STABILITY AT THE SSC**
Samuel Heifets [1987] 47 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-027) Avail: NTIS HC A03/MF A01

The present situation regarding one-particle dynamics in a collider such as the Superconducting Super Collider (SSC) is reviewed. Specific topics addressed include: Hamiltonian forms, perturbation theory and the Lie algebra method, canonical transformations, resonances and the method of averaging, interaction of resonances, structure of the phased space and the residue criterion, crossing of a resonance and synchro-betatron oscillations, modulation diffusion, and noise and noise-resonance interaction. M.G.

**N88-19247#** Department of Energy, Las Vegas, Nev.
**ANNOUNCED UNITED STATES NUCLEAR TESTS: JULY 1945 THROUGH DECEMBER 1986**
Jan. 1987 77 p Prepared in cooperation with Los Alamos National Lab., N. Mex., Lawrence Livermore National Lab., Calif. and Sandia National Labs., Albuquerque, N. Mex.
(NVO-209-Rev-7) Avail: NTIS HC A05/MF A01

This document lists chronologically and alphabetically by event name all nuclear explosions conducted and announced by the United States from July 1945 through December 1986, with the exception of the GMX experiments. Information includes dates, test series, test yields, test locations, and test types and purpose. J.P.B.

**N88-19248#** California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
**ZAP USER'S MANUAL**
Michael S. Zisman, Swapan Chattopadhyay, and Joseph J. Bisognano Dec. 1986 198 p
(Contract DE-AC03-76SF-00098)
(LBL-21270; UC-28; ESG-15) Avail: NTIS HC A09/MF A01

The use and content of Phase 1 of the accelerator physics code ZAP is described. ZAP calculates the performance of a storage ring in terms of the effects of beam-intensity-dependent phenomena and the limitations they impose. The code is an assemblage of tools by which an accelerator physicist can explore

the properties of a particular storage ring design or can perform parameter studies that will elucidate the trade-offs involved in particular choices of parameters. For this reason, the coupling among the various routines is relatively weak, i.e., the outputs or inputs of a particular routine are not, in general, transmitted to subsequent routines. The designer thus has the freedom to explore parameter variations without too many constaints placed by the structure of the code itself. The code has been designed primarily for the study of electron storage rings. However, appropriate modifications for protons and heavy ions have been added for most options. The code was written for a VAX computer. J.P.B.

**N88-19249#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**SEMILEPTONIC WEAK INTERACTIONS IN NUCLEI: A RELATIVISTIC ANALYSIS**
Eun Joo Kim (Stanford Univ., Calif.) 1987 15 p Submitted for publication
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-024) Avail: NTIS HC A03/MF A01

A consistent relativistic formalism is used, with relativistic Hartree wave-functions and a covariant effective current operator with all the properties of the Standard Model, to study semileptonic weak processes in nuclei. Results are obtained for beta-decay, muon-capture, charge-changing neutrino-reactions and neutral neutrino-scattering involving the isodoublet systems F-17 - O-17 and H-3 - He-3. Author

**N88-19250#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**INVESTIGATION OF MULTIPLE PARTICLE FINAL STATES AT CEBAF (CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY)**
Bernhard A. Mecking 1987 12 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-026) Avail: NTIS HC A03/MF A01

The physics motivation for the investigation of multiple particle reactions at the CEBAF 4 GeV electron accelerator is examined. The corresponding requirements for the accelerator and the detector are outlined. Author

**N88-19251#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**RF STEERING IN THE CEBAF CW SUPERCONDUCTING LINAC**
R. C. York and C. Reece (Cornell Univ., Ithaca, N.Y.) 1987 4 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-013) Avail: NTIS HC A02/MF A01

There exists a transverse gradient of the electric field parallel to the beam axis in the fundamental RF power coupler for the superconducting, five-cell cavity to be used in the CEBAF 0.5 to 4.0 GeV, CW, electron accelerator. This electric field gradient results in a transverse deflection of the electrons the magnitude of which varies during the passage of a microbunch, causing a dilution of the transverse emittance. This paper describes the estimate of the transverse deflection and the simulations performed to evaluate the magnitude of the emittance dilution caused by this deflection. The results of these simulations and the method used to reduce this effect are discussed. Author

**N88-19252#** Fermi National Accelerator Lab., Batavia, Ill.
**INITIAL OPERATION OF THE TEVATRON COLLIDER**
Rolland Johnson Mar. 1987 6 p Presented at the 12th Particle Accelerator Conference, Washington, D.C., 16-19 Mar. 1987
(FNAL-TM-1449; M87009036) Avail: NTIS HC A02/MF A01

The Tevatron is now the highest energy proton synchrotron and the only accelerator made with superconducting magnets. Operating since 1983 as a fixed-target machine at energies up to 800 GeV, it has now been modified to operate as a 900 GeV antiproton-proton collider. This paper describes the initial operation of the machine in this mode. The new features of the Fermilab complex, including the antiproton source and the Main Ring injector with its two overpasses and new RF requirements, are discussed. Beam characteristics in the Tevatron (including lifetimes, emittances, luminosity, beam-beam tune shifts, backgrounds, and low beta complications), the coordination of the steps in the accelerator chain, and the commissioning history are also discussed. Finally, some plans for the improvement of the collider are presented. Author

**N88-19253#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**THE CEBAF PROJECT AND ITS FEW-BODY RESEARCH PROGRAM**
Jean Mougey (Commissariat a l'Energie Atomique, Gif-sur-Yvette, France ) 1987 17 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-014) Avail: NTIS HC A03/MF A01

The 4 GeV Continuous Electron Beam Accelerator Facility (CEBAF) planned to be built in Newport News, Virginia, will allow detailed coincidence studies of electrons and photon induced reactions on few body systems, including polarization experiments. The facility and some examples among the planned experimental program are briefly discussed. Author

**N88-19254#** Continuous Electron Beam Accelerator Facility, Newport New, Va.
**TWO DIMENSIONAL SIMULATIONS OF MULTIPASS BEAM BREAKUP**
G. A. Krafft and J. J. Bisognano 1987 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-87-008) Avail: NTIS HC A02/MF A01

A vectorized 2-D beam breakup code, TDBBU, is used to simulate bunch dynamics in recirculating accelerators. First, the code is briefly described, including effects needed to accurately model the CEBAF accelerator. Next, various code tests are sketched. Finally, the multipass beam breakup threshold current is determined to be from 10 to 20 mA for the CEBAF accelerator, a result in agreement with other calculations of the threshold current. Author

**N88-19255#** Los Alamos National Lab., N. Mex.
**AN EXPERIMENTAL MEASUREMENT OF METAL MULTILAYER X-RAY REFLECTIVITY DEGRADATION DUE TO INTENSE X-RAY FLUX Ph.D. Thesis - New Mexico State Univ., Las Cruces**
Mary Yvonne Pottenge Hockaday Jun. 1987 254 p
(LA-10989-T; UC-34) Avail: NTIS HC A12/MF A01

The degradation of the X-ray reflection characteristics of metal multilayer Bragg diffractors due to intense X-ray flux was investigated. Molybdenum-carbon, paladium-carbon, and tungsten-carbon metal multilayers were used. Data for two separate shots were analyzed. For a pure neon gas shot at 420 TW, the reflectivity of the multilayer at 15 cm decayed rapidly with respect to the still-rising signal of the multilayer at 150 cm. The onset time of the decay corresponded to an integrated dose of 5.27 J/sq cm. For a neon implosion onto a vanadium-doped polyacrylic acid foam target shot, detailed modeling was attempted. The spectral flux was determined with data from 5 XRD channels and deconvolved using the code SHAZAM. The observed decay in reflectivity was assumed to correspond to the melting of the first tungsten layer. A conduction factor of 8.9 was required to manipulate the heat loading of the first tungsten layer such that the time of melting corresponded to the observed decay. The power at destruction was 141 MW/sq cm and the integrated energy at destruction was 2.0 J/sq cm. Author

**N88-19256#** California Univ., Berkeley. Lawrence Berkeley Lab.
**PRESENTATIONS TO THE SUPERHILAC PROGRAM ADVISORY COMMITTEE**
R. J. McDonald, ed. Sep. 1987 279 p Meeting held in Berkeley, Calif., 10 Sep. 1987
(Contract DE-AC03-76SF-00098)

(DE88-003853; LBL-24169; CONF-8709210) Avail: NTIS HC A13/MF A01

This paper contains viewgraphs on the SuperHILAC. The topics of these viewgraphs are: light charged particle emission as a probe of heavy-ion reactions; correlated charged-changing interactions and X-ray emission in ion-atom collisions; progress report on Sassy II and new nuclear chemistry experiments at the SuperHILAC; precision X-ray spectroscopy of heavy ions; 180(0)-correlated equal energy photons from 5.9 MeV/N U + Th collisions; research statement of excited states of monatomic and molecular systems; search for entrance-channel effects in the production of superdeformed nuclei; present and future research with OASIS; relaxation mechanisms in damped heavy-ion reactions; excitation energy division and nucleon transfer; test of QED and relativistic effects for strongly-bound electrons; heavy-ion Coulomb excitation and transfer reactions as probes of nuclear structure; and preliminary design of the Dilepton spectrometer. DOE

**N88-19257#** California Univ., Berkeley. Lawrence Berkeley Lab.
**MECHANICAL DESIGN AND CONSTRUCTION OF A 200 mA, 100 keV, dc, NEGATIVE ION ACCELERATOR**
P. Purgalis, O. A. Anderson, W. S. Cooper, C. Cummings, G. W. Koehler, C. A. Matuk, and R. P. Wells Oct. 1987 5 p Presented at the 12th Symposium on Fusion Engineering, Monterey, Calif., 12 Oct. 1987
(DE88-003855; LBL-23269; CONF-871007-79) Avail: NTIS HC A02

A volume production source and a 100 keV, dc, accelerator together with an additional, modular, 100 keV, electro static focused accelerator provide a starting point for a high energy H(-)/D(-) beam-line (200 keV to 800 keV), intended for fusion energy applications. The 100 keV accelerator tests started in June 1987. The mechanical design and construction of the accelerator is described. DOE

**N88-19258#** Lawrence Livermore National Lab., Calif.
**INDUCTION LINACS: A TECHNOLOGY COME OF AGE FOR INTERNATIONAL COOPERATION**
W. A. Barletta 1987 11 p Presented at the 7th Session of the International Seminars on Nuclear War, Erice, Italy, 19 Aug. 1987
(Contract W-7405-eng-48)
(DE88-003953; UCRL-97618; CONF-8708201-1) Avail: NTIS HC A03/MF A01

Recent developments in high reliability components for linear induction accelerators (LIA) make possible the use of LIAs as large scale, economical sources of radio-frequency (RF) power for many large scale applications considered as World Laboratory projects. One particularly attractive example of interest to high energy physicists is a two-beam accelerator version of a linear e(+)-e(-) collider at TeV energies in which the LIA is configured as a monolithic relativistic klystron operating at 10 to 12 GHz. Another example of keen interest to the fusion community is the use of the LIA to drive a free-electron laser operating at 200 to 500 GHz for use in heating fusion plasmas via electron resonance cyclotron heating (ERCH). This paper describes briefly several potential uses of LIA radiation sources and scales present experience with LIAs to the operating characteristics applicable to large sources of RF power and synchrotron radiation. DOE

**N88-19259#** Fermi National Accelerator Lab., Batavia, Ill.
**CHANNELING AND DECHANNELING AT HIGH ENERGY**
R. A. Carrigan, Jr. 30 Sep. 1987 27 p Presented at the 12th International Conference on Atomic Collisions in Solids, Okayama, Japan, 12 Oct. 1987
(Contract DE-AC02-76CH-03000)
(DE88-003989; FNAL/C-87/149; CONF-8710159-6) Avail: NTIS HC A03/MF A01

The possibility of using channeling as a tool for high energy particle physics has now been extensively investigated. Bent crystals have been used as an accelerator extraction element and for particle deflection. Applications as accelerating devices have been discussed but appear remote. The major advantage in using a bent crystal rather than a magnet is the large deflection that can be achieved in a short length. The major disadvantage is the low transmission. A good understanding of dechanneling is important for applications. DOE

**N88-19260#** Fermi National Accelerator Lab., Batavia, Ill.
**A PRACTICAL GUIDE TO MODERN HIGH ENERGY PARTICLE ACCELERATORS**
S. D. Holmes Oct. 1987 26 p Presented at the Theoretical Advanced Summer Institute, Santa Fe, N. Mex., 6 Jul. 1987
(Contract DE-AC02-76CH-03000)
(DE88-004035; FNAL/C-87/160; CONF-8707141-1) Avail: NTIS HC A03/MF A01

The purpose of these lectures is to convey an understanding of how particle accelerators work and why they look the way they do. The approach taken is physically intuitive rather than mathematically rigorous. The emphasis is on the description of proton circular accelerators and colliders. Linear accelerators are mentioned only in passing as sources of protons for higher energy rings. Electron accelerators/storage rings and antiproton sources are discussed only by way of brief descriptions of the features which distinguish them from proton accelerators. The basics of how generic accelerators work are discussed, focusing on descriptions of what sets the overall scale, single particle dynamics and stability, and descriptions of the phase space of the particle beam, the information thus presented is then used to go through the exercise of designing a Superconducting Super Collider. DOE

# 74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers*.

**N88-19261#** North Carolina Univ., Chapel Hill.
**THE ANALYTICAL EXPONENTIAL DECAY COEFFICIENT OF THE SUBMARINE LIGHT FIELD Annual Report**
Robert H. Stavn 1986 47 p
(Contract N00014-86-K-0606)
(AD-A187215) Avail: NTIS HC A03/MF A01 CSCL 20F

The role of the Lambert-Beer law in ocean optics is critically examined. The Lambert-Beer law and the Three-parameter Model of the submarine light field are used to construct an optical energy budget for any hydrosol. It is further applied to the analytical exponential decay coefficient of the light field and used to estimate the optical properties and effects of the dissolved/suspended component in upper ocean layers. The concepts of the empirical exponential decay coefficient (diffuse attenuation coefficient) of the light field and a constant exponential decay coefficient for molecular water are analyzed quantitatively. A constant exponential decay coefficient for water is rejected. The analytical exponential decay coefficient is used to analyze optical gradients in ocean waters. GRA

**N88-19262#** Scripps Institution of Oceanography, La Jolla, Calif. Visibility Lab.
**REMOTE SENSING OF ATMOSPHERIC OPTICAL THICKNESS AND SEA-WATER ATTENUATION WHEN SUBMERGED: WAVELENGTH SELECTION AND ANTICIPATED ERRORS Final Report, 1 Jul. 1978 - 30 Apr. 1986**
T. J. Petzold and R. W. Austin Jul. 1987 84 p
(Contract N00014-78-C-0556)
(AD-A187609; SIO-REF-87-18) Avail: NTIS HC A05/MF A01 CSCL 20F

Prior analysis and experimentation has provided strong support for determining the attenuation of optical radiation for the atmosphere and the water column above a submerged platform by measuring the absolute downwelling irradiance at two wavelengths. The technique requires knowing the two irradiance values and also: (1) the spectral irradiance of the Sun outside the atmosphere; (2) the solar zenith angle; and (3) the depth at which

the irradiances are measured. With this capability in hand, the questions considered in this report are which wavelengths to use and the effect of errors in the measurement of irradiance and other parameters. GRA

**N88-19263#** Naval Research Lab., Washington, D.C.
**COMPUTER MODELING FOR OPTICAL WAVEGUIDE SENSORS Memorandum Report, Jun. 1986 - Jan. 1987**
J. F. Giuliani and P. P. Bey, Jr. 15 Dec. 1987 25 p
(AD-A187702; NRL-MR-6071) Avail: NTIS HC A03/MF A01 CSCL 07D

A two-layer model for the analysis of an optical waveguide chemical vapor sensor is developed using a program written for a low cost personal computer (PC), which takes into account a non-adsorbing glass/fluid interface, the number of optical reflections, and probe beam divergence, for angles of incidence which are skewed about the critical angle for total internal reflection. This model is applied in the analysis of condensed organic vapors employing an uncoated optical thin-walled glass capillary device developed at the Naval Research Laboratory (NRL). Reasonable agreement is obtained between the experimental results and model predictions. GRA

**N88-19264#** Stanford Univ., Calif. Electronics Lab.
**OPTICAL COMPUTING RESEARCH Final Report, 30 Sep. 1986 - 30 Sep. 1987**
Joseph W. Goodman 30 Oct. 1987 81 p
(Grant AF-AFOSR-0283-86)
(AD-A187862; AFOSR-87-1635TR) Avail: NTIS HC A05/MF A01 CSCL 20F

Work Accomplished: OPTICAL INTERCONNECTIONS - the powerful interconnect abilities of optical beams have led much optimism about the possible roles for optics in solving interconnect problems at various levels of computer architecture. Examined were the powerful requirements of optical interconnects at the gate-to-gate and chip-to-chip levels. OPTICAL NEUTRAL NETWORKS - basic studies of the convergence properties on the Hofield model, based on mathematical approach - graph theory. OPTICS AND ARTIFICIAL INTELLIGENCE - review the field of optical processing and artificial intelligence, with the aim of finding areas that might be particularly attractive for future investigation(s). GRA

**N88-19265#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**DEVELOPMENT OF VLSI OPTICAL DATA LINK Quarterly Status Report Nos. 1 and 2, 1 Sep. 1986 - 28 Feb. 1987**
P. G. McMullin and R. L. Messham 16 Sep. 1987 39 p
(Contract DAAL01-86-C-0023)
(AD-A187883) Avail: NTIS HC A03/MF A01 CSCL 25E

The deposition of GaAs epilayers onto the silicon epilayer of an SOS wafer has proven to be a relatively robust process, insensitive to variations in substrate orientation, cleaning, preconditioning, growth rate and temperature, and composition of the deposited layer. Deposition onto sapphire substrates has not yet given GaAs epilayers of high quality. The best approach for obtaining device-quality GaAs appears to be through utilization of the silicon epilayer as the base for the GaAs deposition. Experiments will be carried out to improve the quality of GaAs layers deposited directly onto sapphire. GRA

**N88-19266#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**DEVELOPMENT OF VLSI OPTICAL DATA LINK Quarterly Status Report No. 3, 1 Mar. - 30 May 1987**
P. G. McMullin and R. L. Messham 1 Oct. 1987 13 p
(Contract DAAL01-86-C-0023)
(AD-A187884) Avail: NTIS HC A03/MF A01 CSCL 25E

This report covers a sequence of epitaxial growth runs on sapphire substrates. The gallium arsenide films resulting do not have as good a surface morphology as the films previously grown on silicon-on-sapphire substrates. However, the films are highly oriented with respect to the substrate and controllable to obtain 111 or 100 orientation. Further optimization of deposition on sapphire substrates will be continued while the main thrust of the program will be directed to the formation of devices fabricated in gallium arsenide layers deposited onto the silicon epilayer of SOS substrates for evaluation purposes. GRA

**N88-19267#** RTS Labs., Inc., Alachua, Fla.
**MULTIAPERTURE OPTICAL SYSTEM RESEARCH Final Report, 1985 - 1987**
Richard T. Schneider 6 Nov. 1987 135 p
(Contract N00014-85-C-0862)
(AD-A188211; Rept-110687) Avail: NTIS HC A07/MF A01 CSCL 20F

A basic and applied research program concerned with multiaperture optics is described. The intent is to explore to what extent the principles of the insect eye can be incorporated into the design of optical instruments. The advantages and disadvantages of multiaperture optics are investigated in the basic part of the program. The applied part of the program was devoted to the design and construction of prototype instruments based on the design information generated during the basic part of the program. GRA

**N88-19268#** Lawrence Livermore National Lab., Calif.
**ADVANCES IN X-RAY OPTICS, 1987**
N. M. Ceglio Sep. 1987 16 p Presented at the International Symposium on X-Ray Microscopy, Long Island, N.Y., 3 Sep. 1987
(Contract W-7405-eng-48)
(DE88-003298; UCRL-97612; CONF-8709216-1) Avail: NTIS HC A03/MF A01

This contribution is the third in a series of review articles, on recent developments in X-ray optics by the Advanced X-ray Optics Group at Lawrence Livermore National Laboratory and it's collaborators. In the past three years significant progress has been made in the development of novel X-ray sources, X-ray optical components, and X-ray detectors. DOE

**N88-19269#** Sandia National Labs., Albuquerque, N. Mex.
**COHERENT VUV SOURCE AT 130 nm: THEORY AND MODELING**
A. V. Smith, G. R. Hadley, and W. J. Alford 1988 10 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-003874; SAND-87-2950C; CONF-880110-7) Avail: NTIS HC A02/MF A01

The goal of this research is to maximize conversion efficiency of sum-frequency mixing in an energy scalable system. The 130.2-nm generation via two-photon-resonant four-wave mixing in Hg vapor for unfocused light beams emphasizing an understanding of efficiency-limiting processes has been analyzed. Calculations, based on measurements of Hg dipole matrix elements, indicate that mixing efficiencies of 5 to 10 percent should be possible. DOE

**N88-19270#** Lawrence Livermore National Lab., Calif.
**SOFT X-RAY BEAMSPLITTERS AND HIGHLY DISPERSIVE MULTILAYER MIRRORS FOR USE AS SOFT X-RAY LASER CAVITY COMPONENTS**
A. M. Hawryluk, N. M. Ceglio, D. G. Stearns, K. Danzmann, M. Kuehne, P. Muller, and B. Wende 12 Jan. 1987 12 p Presented at the 30th SPIE Technical Symposium on Optics and Optoelectronic Engineering, San Diego, Calif., 17 Aug. 1986 Prepared in cooperation with Physikalisch-Technische Bundesanstalt, Berlin, Fed. Republic of Germany
(Contract W-7405-eng-48)
(DE88-004003; UCRL-95969; CONF-860880-57) Avail: NTIS HC A03/MF A01

The demonstration of amplified spontaneous emission at soft X-ray wavelengths has highlighted the need for normal incidence optics for soft X-rays. Specifically, X-ray laser cavity components will be needed to further advances in X-ray laser research. In this paper, we present the fabrication, characterization and analysis of

two possible cavity components, an X-ray beamsplitter and a highly dispersive multilayer mirror. Each of these can be used as X-ray laser cavity output couplers. DOE

**N88-19271#** Paderborn Univ. (West Germany). Fachbereich Physik.
**OPTICAL FREQUENCY DOUBLING IN TI:LIMbO3 WAVEGUIDE RESONATORS Ph.D. Thesis [OPTISCHE FREQUENZVERDOPPLUNG IN TI:LINBO3 WELLENLEITERRESONATOREN]**
Rolf Regener 1986 93 p In GERMAN
(ETN-88-91486) Avail: NTIS HC A05/MF A01

Optical frequency doubling in titanium-diffused lithium niobate waveguide resonators was investigated. The theoretical model for waveguides with damping is based on the production of the second harmonic in crystals. The waveguide resonator was described by a flat Fabry-Perot resonator with damping. It is shown that the resonator concept, and especially that of the adapted good-quality resonator, leads to a substantial improvement of the conversion efficiency for frequency doubling as compared to a nonresonant waveguide. A method for the determination of the resonator damping was developed. Optically induced refractive index changes in LiNbO3 were investigated, and possible solutions are discussed. A concept for the practical application of optical frequency doubling is demonstrated. Efficient frequency doubling with semiconductor lasers seems realistic. ESA

**N88-19272** Pennsylvania Univ., Philadelphia.
**PREDICTION AND ANALYSIS OF BASIC GRAVITATIONAL MICROLENSING PHENOMENA Ph.D. Thesis**
Robert J. Nemiroff 1987 180 p
Avail: Univ. Microfilms Order No. DA8725193

The phenomena of gravitational microlensing are described, and predictions are made about its possible future detection. A mathematical formalism is developed which exploits gravitational lensing effects in terms of photometric measuring capability. The formalism is then used to outline the most probable places to look for microlensing. Basic microlensing induced light curves are calculated for a variety of possible lens-source configurations. These configurations include that of a single star acting as a lens, and that of a double star acting as the lens. The light curve signatures of the double star are themselves indicators of the microlensing phenomenon. Light curve signatures for a single star acting on a uniform extended source are presented. Analysis is described listing methods by which parameters taken from this light curve could be used to recover both lens and source information. The effect of microlensing on the shape of the spectral lines originating in the broad line emission region (BLR) of an active galactic nucleus (AGN) is analyzed. A sample finding list of Quasi-Stellar Objects (QSOs) is presented for observers. For the assumption of galaxies made up entirely of compact objects, calculations are presented for each QSO on the list, listing optical depth for microlensing, the average time between microlensing events of various amplitudes, and the expected duration of an event. Possible observing programs are described.
Dissert. Abstr.

**N88-19273** Kansas State Univ., Manhattan.
**OPTICALLY COUPLED TACTILE SENSOR ARRAY FOR ROBOTICS Ph.D. Thesis**
Richard Clifford Hochberg 1987 144 p
Avail: Univ. Microfilms Order No. DA8724684

This research develops the theory and construction of a one-cell fiber optic reflective sensor using 1000 micron solid-core plastic fiber optic cable. The information gained from a one-cell sensor was expanded onto a four-cell model, and then used to construct an 8 by 8 array. Results obtained from the array showed that large core plastic fiber optic cables can be used, instead of the current fiber optic sensor industry standard bundle cable technology, in building inexpensive, reliable reflective fiber optic tactile sensors. Information obtained from the tactile sensor system is displayed numerically in a visual format. An optical symbolic format is also available. Both displays give an indication of the relative intensity of the sensor's compliant medium's displacement in relation to the exerted pressure on the sensor surface, as well as visual shape and orientation changes. This information is then available to be evaluated using established pattern recognition techniques to identify known patterns, shapes, or outlines. The system identifies point sources and relative shapes, though the compliant medium used appears to limit the sensor's resolution. A suggested improved compliant medium concept is presented.
Dissert. Abstr.

**N88-19274#** National Academy of Sciences - National Research Council, Washington, D. C.
**NIGHT VISION: CURRENT RESEARCH AND FUTURE DIRECTIONS, SYMPOSIUM PROCEEDINGS**
1987 338 p Symposium held in San Antonio, Tex., Oct. 1985 Sponsored in part by School of Aerospace Medicine, Brooks, AFB, Tex.
(Contract N00014-80-C-0159)
(PB88-132006) Avail: NTIS HC A15/MF A01 CSCL 20F

Present understanding of research directions in the area of night vision is examined. An account is provided of the visual processes involved in night vision and of the perceptual, cognitive, and human factors issues related to the performance of visually guided tasks under low-illumination conditions. Available screening procedures are addressed for the testing of night vision capabilities and some of the more promising directions for further development of tests in this area. The latest instrumentation involved in night vision research is reviewed and the elements of a comprehensive night vision laboratory described. The findings and recommendations of the working group will be of particular interest to those involved in the assessment and selection of military personnel, those engaged in the design of equipment for visually guided night operations, and those whose basic research activities continue to strengthen the knowledge base in this area. GRA

**N88-19275#** Sandia National Labs., Albuquerque, N. Mex.
**NONLINEAR OPTICAL WAVEGUIDES CONTAINING A TRANSITION METAL-BASED DYE MOLECULE**
P. A. Cahill 1987 9 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003257; SAND-87-1521C; CONF-871124-41) Avail: NTIS HC A02/MF A01

Two pentaamine malonitrile ruthenium dyes that show sharp and intense absorption maxima near 800 nm have been synthesized for use as nonlinear optical (NLO) dyes. Preliminary powder measurements of crystals of these dyes for second harmonic generation (SHG) are reported for incident 1064 nm light. The anomalous dispersion due to the location of the one-photon absorption maximum has interesting consequences for phase matching, and calculations for inherently phase-matched single-mode waveguides are presented. DOE

**N88-19276#** California Univ., Berkeley. Lawrence Berkeley Lab.
**MULTILAYER-COATED MIRRORS AS POWER FILTERS IN SYNCHROTRON RADIATION BEAMLINES**
J. B. Kortright, P. Plag, R. C. C. Perera, P. L. Cowan, D. W. Lindle, and B. Karlin Jul. 1987 23 p Presented at the 5th National Synchrotron Radiation Instrumentation Conference, Madison, Wisc., 21 Jun. 1987 Prepared in cooperation with National Bureau of Standards, Washington, D.C. and Brookhaven National Lab., Upton, N.Y.
(Contracts DE-AC03-76SF-00098; DE-AC02-76CH-00016)
(DE88-003872; LBL-24000; CONF-870610-18) Avail: NTIS HC A03/MF A01

Multilayer-coated mirrors, rather than conventional total-reflection mirrors, have been proposed as a means to reduce power incident on the first optical element of high resolution monochromators. We have designed, fabricated, installed and characterized a multilayer pre-mirror specifically for the 800 to 4000 eV range for the X24-A bending magnet beamline at the National Synchrotron Light Source. Various aspects of this

application are discussed, including power and thermal considerations, beamline layout considerations and constraints, choice of multilayer materials and substrate, and techniques to ensure lateral uniformity of the multilayer. Results of a preliminary characterization of a mirror coated with a SiC/V multilayer and installed in the beamline are also discussed. DOE

**N88-19277#** Lawrence Livermore National Lab., Calif.
**RADIATION EFFECTS ON GALLIUM ARSENIDE INTEGRATED OPTICAL DEVICES**
G. McWright, M. Lowry, F. Roeske, E. Takeuchi, W. Tindall, and G. Murphy Aug. 1987 6 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-004107; UCRL-96219; CONF-8708110-31) Avail: NTIS HC A02/MF A01

We discuss gallium arsenide integrated optical devices for high speed diagnostic systems. Specifically, we focus on the effect of radiation exposure on the performance characteristics of these devices. DOE

**N88-19278#** Oak Ridge National Lab., Tenn.
**OPTICAL WAVEGUIDE FORMATION BY ION IMPLANTATION OF Ti OR Ag**
D. B. Poker and D. K. Thomas Dec. 1987 7 p Presented at the Symposium on Fundamentals of Beam-solid Interactions and Transient Thermal Processing, Boston, Mass., 30 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004595; CONF-8711126-1) Avail: NTIS HC A02/MF A01

Ion implantation of Ti into LiNbO3 has been shown to be an effective means of producing optical waveguides, while maintaining better control over the resulting concentration profile of the dopant than can be achieved by in-diffusion. While undoped, amorphous LiNbO3 can be regrown by solid-phase epitaxy at 400 C with a regrowth velocity of 250 A/min, the higher concentrations of Ti required to form a waveguide (approx. 10 percent) slow the regrowth considerably, so that temperatures approaching 800 C are used. Complete removal of residual damage requires annealing temperatures of 1000 C, not significantly lower than those used with in-diffusion. Solid phase epitaxy of Ag-implanted LiNbO3, however, occurs at much lower temperatures. The regrowth is completed at 400 C, and annealing of all residual damage occurs at or below 800 C. Furthermore, the regrowth rate is independent of Ag concentration up to the highest dose implanted to date, 1 x 10 to the 17th power Ag/sq cm. The usefulness of Ag implantation for the formation of optical waveguides is limited, however, by the higher mobility of Ag at the annealing temperature, compared to Ti. DOE

**N88-19279#** Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
**FAST SWITCHING OF FAR INFRARED RADIATION BY REFRACTIVE INDEX CHANGE IN SEMICONDUCTORS USING PHOTOIONIZATION Ph.D.Thesis [SCHNELLES SCHALTEN VON FERNINFRAROT-STRAHLUNG DURCH BRECHUNGSINDEXAENDERUNG IN HALBLEITERN UEBER PHOTOIONISATION]**
Thomas Vogel 1986 76 p In GERMAN
(ETN-88-91490) Avail: NTIS HC A05/MF A01

The optical switching of FIR radiation in the subnanosecond range was investigated. The 119 micron radiation of a water-vapor laser can be switched in less than an n sec with a modulation degree of up to 85 percent by the excitation of Si and GaAs with nitrogen laser pulses. The switching times were measured by a sampling technique. The reflection and transmission behavior of the Si switch was registered on real-time oscilloscopes in the 100 microns-long relaxation phase after the UV excitation. The scaling of switching time and modulation degree with UV pulse energy was determined. The experimental results agree well with the numerical results of a one-dimensional model calculation. Characteristic deviations indicate heating effects and hence a reduction of charge carrier mobility during the excitation phase due to the UV pulse. ESA

**N88-19280*#** San Diego State Univ., Calif. Dept. of Astronomy.
**RUNNING HEAD: WHAT COLOR IS IT Final Report**
Andrew T. Young 17 Mar. 1988 71 p
(Grant NAGw-250)
(NASA-CR-182600; NAS 1.26:182600) Avail: NTIS HC A04/MF A01 CSCL 20F

Color vision provides low-resolution spectrophotometric information about candidate materials for planetary surfaces that is comparable in precision to wideband photoelectric photometry, and considerably superior to Voyager TV data. Briefly explained are the basic concepts, teminology, and notation of color science. Also shown is how to convert a reflectance spectrum into a color specification. An Appendix lists a simple computer subroutine to convert spectral reflectance into CIE coordinates, and the text explains how to convert these to a surface color in a standard color atlas. Target and printed Solar System colors are compared to show how accurate are the printed colors. Author

**N88-18792*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**OPTICAL LINKS IN THE ANGLE-DATA ASSEMBLY OF THE 70-METER ANTENNAS**
M. D. Nelson, J. R. Schroeder, and E. F. Tubbs *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1988 p 154-165 (For primary document see N88-18774 11-32)
Avail: NTIS HC A10/MF A01 CSCL 20F

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N88-19281#** Schafer (W. J.) Associates, Inc., Pleasanton, Calif.
**ICF SPECIAL STUDIES Final Report**
W. R. Meier 16 Sep. 1987 5 p
(Contract W-7405-eng-48)
(DE88-004057; UCRL-15978) Avail: NTIS HC A02/MF A01

This paper summarizes the work completed by W.J. Schafer Associates for Lawrence Livermore National Laboratory in the area of Inertial Confinement Fusion. The SAFIRE (Systems Analysis Code for ICF Reactor Economics) code is one of the major tasks discussed. DOE

**N88-19282#** InterScience, Inc., Troy, N.Y.
**TOROIDAL CONFINEMENT RESEARCH CONCEPTS EVALUATION AND TRADEOFF STUDIES Project Status Report, 1-30 Sep. 1987**
1987 9 p
(Contract DE-AC01-85ER-51088)
(DE88-004277; DOE/ER-51088/T20) Avail: NTIS HC A02/MF A01

This paper investigates different conceptual aspects of toroidal confinement. Topics covered include energy multiplication factors for the TFTR tokamak, CIT physics and engineering, and Joint European Torus (JET) auxiliary heating and energy multiplication factors. DOE

**N88-19283#** Office of Technology Assessment, Washington, D.C.
**STARPOWER: THE US AND THE INTERNATIONAL QUEST FOR FUSION ENERGY**
Oct. 1987 247 p
(PB88-128731; OTA-E-338; LC-87-619854) Avail: NTIS HC A11/MF A01; also available SOD HC $10.00 as 052-003-010-79-8 CSCL 20I

The status of magnetic confinement fusion research is reviewed and compared with the requirements for development of a useful

energy technology. Inertial confinement fusion research is not analyzed. Some topics covered are: history of fusion research; fusion science and technology; fusion as an energy program; fusion as a research program; fusion as an international program; and future paths for the magnetic fusion program. Appendixes include: nonelectric applications for fusion; other approaches to fusion; data for figures; etc. Author

**N88-19284#** Oak Ridge National Lab., Tenn.
**LOW ASPECT RATIO TORSATRONS**
B. A. Carreras, N. Dominguez, L. Garcia, V. E. Lynch, J. F. Lyon, J. R. Cary, J. D. Hanson, and A. P. Navarro (European Atomic Energy Community, Madrid, Spain ) 1987 19 p Presented at the US/Japan Heliotron-stellarator Workshop, Oak Ridge, Tenn., 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004173; CONF-871179-11-Vugraphs) Avail: NTIS HC A03/MF A01

This paper discusses a move toward a more compact stellarator that could be a more attractive fusion reactor. DOE

**N88-19285#** InterScience, Inc., Germantown, Md.
**TOROIDAL CONFINEMENT RESEARCH CONCEPTS EVALUATION AND TRADEOFF STUDIES Project Status Report, 1-30 Nov. 1987**
25 Jan. 1988 9 p
(Contract DE-AC01-85ER-51088)
(DE88-004841; DOE/ER-51088/T22) Avail: NTIS HC A02

Progress and conclusions drawn from attendance at a meeting of the Division of Plasma Physics, American Physical Society, held in San Diego, California are discussed. DOE

**N88-19286#** Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
**FUSION, AND ADVANCED FUEL, REACTION BIBLIOGRAPHY: PARTICLE REACTIONS FROM H1 TO B11 Special Report, 17 Feb. - 17 Aug. 1987**
H. H. Pass, Jr. Aug. 1987 31 p
(AD-A187420; AFAL-TR-87-073) Avail: NTIS HC A03/MF A01 CSCL 18A

The Air Force Astronautics Laboratory has an ongoing program of studying the feasibility of fusion powered propulsion. This study will first examine nuclear fuels and their associated fuel cycles. The investigated fuels and fuel cycles will then be used to explore present and proposed fusion propulsion concepts. From this study, it will be determined which concepts, if any, will be able to produce fusion propulsion systems using present or near term technology. The objective of the work reported herein was to compile a comprehensive list of the experimentally measured nuclear reactions involving the nuclides up to and including B11 (Boron-11). This compilation was performed in order to identify any new fuels and/or fuel cycles that would be potential candidates to replace the presently utilized fuels deuterium and tritium. Also, the project is intended to provide a readily accessible source of information for individuals who are studying fuels, reactions, and fuel cycles. GRA

**N88-19287#** Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
**AN ANALYSIS OF WHISTLER-MODE RADIATION FROM THE SPACELAB-2 ELECTRON BEAM, REVISION Progress Report**
W. M. Farrell, D. A. Gurnett, P. M. Banks, R. I. Bush, and W. J. Raitt 7 Aug. 1987 42 p
(Contract N00014-85-K-0404)
(AD-A188228; U. of IOWA-87-19-REV) Avail: NTIS HC A03/MF A01 CSCL 20N

During the shuttle's Spacelab-2 mission, the Plasma Diagnostics Package (PDP) was released from the shuttle to freefly. At times during this freeflight when the PDP was magnetically connected to the shuttle, the Fast Pulsed Electron Generator (FPEG), located in the shuttle cargo bay, ejected a 1 keV to 50 mA electron beam. The plasma wave instrument on board the PDP detected intense whistler mode radiation during these beam ejections. This paper presents a study of a whistler mode emission detected during one particular continuous electron beam firing. Calculations indicate that the beam radiated approximately 1.6 mW in the whistler mode as the beam transversed the 200 meters from the shuttle to the PDP. The emissivity also decreased by about a factor of 10 over this same distance. The measured wave powers are 10 to the 7th power greater than wave powers expected from incoherent Cerenkov radiation, verifying that the radiation is generated by a coherent process. Estimates of the emissivity based on measured electric field intensities in the beam indicate that the whistler mode noise is produced by radiation from electron bunches created by an electrostatic beam plasma instability. GRA

**N88-19288#** Lawrence Livermore National Lab., Calif.
**MAGNETIC AND INERTIAL FUSION STATUS AND DEVELOPMENT PLANS**
D. Correll and E. Storm Dec. 1987 15 p Presented at the 8th Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., 14 Dec. 1987
(Contract W-7405-eng-48)
(DE88-004405; UCRL-96570; CONF-871204-1) Avail: NTIS HC A03/MF A01

Controlled fusion, pursued by investigators in both the magnetic and inertial confinement research programs, continues to be a strong candidate as an intrinsically safe and virtually inexhaustible long-term energy source. We describe the status of magnetic and inertial confinement fusion in terms of the accomplishments made by the research programs for each concept. The improvement in plasma parameters (most frequently discussed in terms of the Tn tau product of ion temperature, T, density, n, and confinement time, tau) can be linked with the construction and operation of experimental facilities. The scientific progress exhibited by larger scale fusion experiments within the US, such as Princeton Plasma Physics Laboratory's Fusion Test Reactor for magnetic studies and Lawrence Livermore National Laboratory's Nova laser for inertial studies, has been optimized by the theoretical advances in plasma and computational physics. Both the Tokamak Fusion Test Reactor (TFTR) and Nova have exhibited ion temperatures in excess of 10 keV at confinement parameters of n tau near 10 to the 13th power cm (-3) sec. At slightly lower temperatures (near a few keV), the value of n tau has exceeded 10 to the 13th power cm (-3) sec in both devices. DOE

**N88-19289#** Lawrence Livermore National Lab., Calif.
**SPECTRAL LINE-BROADENING CODES FOR HYDROGEN-, HELIUM- AND LITHIUM-LIKE IONS IN PLASMAS**
R. W. Lee Dec. 1987 30 p
(Contract W-7405-eng-48)
(DE88-005238; UCID-21292) Avail: NTIS HC A03/MF A01

Information is provided on a set of three computer codes that allow the casual user to generate, accurately and rapidly, the spectral line profiles from certain transitions of hydrogen-, helium-, and lithium-like ions in a plasma. The codes produce state-of-the-art profiles instantly (when you sit at the Cray) and provide the type of answers which are required for diagnostics and for laser gain estimations. DOE

**N88-19290#** Australian Inst. of Nuclear Science and Engineering, Lucas Heights.
**SIXTEENTH AINSE PLASMA PHYSICS CONFERENCE. CONFERENCE HANDBOOK**
1987 107 p Conference held in Lucas Heights, Australia, 9 Feb. 1987
(DE88-700825; INIS-mf-11089; CONF-870207) Avail: NTIS (US Sales Only) HC A06/MF A01

Abstracts of papers, the conference program and general information on the 16th AINSE Plasma Physics Conference are included in the conference handbook. DOE

**N88-19291** Brigham Young Univ., Provo, Utah.
**SIMULATION OF THE PLASMA INTERACTION WITH THIN DUST CLOUDS Ph.D. Thesis**

Gordon Ray Wilson 1987 149 p
Avail: Univ. Microfilms Order No. DA8725032

The rings of Saturn, being immersed in a plasma and exposed to ultraviolet radiation from the sun, will be electrically charged. The charging of the rings is studied through the numerical solution of the Boltzmann equation. The work includes the effect of plasma loss and photoelectron production within the rings. Several aspects of the ring structure (thickness, average particle size, cross sectional profile, and optical depth) can be varied to illustrate the effect of these parameters on the resulting charge. The solution for several cases at low plasma density and high plasma density are presented. The results have implications for several processes occurring in the rings. The amount of current carried by the rings may be an order of magnitude larger than the amount estimated by charging studies which use a flat plate description of the rings. If spokes form, the rings must be very thin with tightly packed particles. The disruption and accretion of small dust grains within the rings may be greatly enhanced by the strong electric fields there. The charging processes considered here are probably not the source of the Saturn Electrostatic Discharge ratio emissions although they may contribute to the lower frequency portion of the Saturn Kilometric Radiation emissions. Dissert. Abstr.

**N88-19292** Maryland Univ., College Park.
**SPECTROSCOPIC STUDIES OF A LASER-PRODUCED CARBON PLASMA IN THE NEAR AND EXTREME ULTRAVIOLET Ph.D. Thesis**
Enrique Jose Iglesias 1987 138 p
Avail: Univ. Microfilms Order No. DA8725512

This work deals mainly with the line emission from CV and CVI ions in a plasma produced when a ruby laser pulse is focused onto a polyethelene target under vacuum. The plasma emission was temporally and spatially resolved using near ultraviolet (NUV) and extreme ultraviolet (XUV) diagnostics. In the NUV, line profiles were measured of the delta $n = 0$, $n = 2$ transitions of CV and then $n = 7$ to 6 transition of CVI at 3 mm from the target surface. In the XUV, the profiles were measured of members of the Lyman series of (H alpha, H beta) of the Balmer series of CVI close to the target surface. Also measured were the helium-like and hydrogen-like recombination continua. By comparing the profiles of H alpha with recent theoretical estimates of the Stark broadening of this line, it was found that the fine structure components, together with an overall Doppler contribution, are necessary in order to explain the experimental profile. Dissert. Abstr.

**N88-19293** California Univ., Davis.
**EXPERIMENTAL STUDY OF SCATTERED WAVES AND CYLINDRICAL ANTENNA SHEATHS IN A MICROWAVE DRIVEN PLASMA Ph.D. Thesis**
Mary Anne Kodis 1987 123 p
Avail: Univ. Microfilms Order No. DA8723401

A short wire antenna was immersed in a quiescent, weak gradient underdense plasma. The system was irradiated at low power with 1.2 GHz microwaves. Spectra received from the antenna show three strong down-scattered frequencies: the half-harmonic of the driver and a pair of frequencies equidistant above and below the driver. These frequencies are described as a symmetric pair. The growth and decay of these signals is investigated as well as their variation with the plasma density and the effects of the antenna sheath with a view to distinguishing among various processes suggested for their generation. It is postulated that gradient-driven two-plasmon decay in the sheath and/or presheath of the probe is the source of the half-harmonic signal. The extreme plasma density gradients found in a sheath offer high growth rate conditions for this parametric instability. The observed threshold lies between the thresholds calculated for the cases of collisional and convective losses. The very low minimum density suggests that Landau damping is suppressed in the sheath.
Dissert. Abstr.

**N88-19294** Alabama Univ., Huntsville.
**AN ADAPTIVE GRID FINITE DIFFERENCE METHOD FOR TIME-DEPENDENT MAGNETOHYDRODYNAMIC (MHD) FLOWS AND ITS ASTROGEOPHYSICAL APPLICATIONS Ph.D. Thesis**
Supat Panitschob 1987 303 p
Avail: Univ. Microfilms Order No. DA8724342

An adaptive grid finite difference method for solving time dependent, magnetohydrodynamic (MHD) equations is developed. The method is capable of solving problems that include high gradients due to geometry, propagation of shock waves and unsteady boundary conditions. The grid generation technique is based on variational principles with direct control over grid concentration, smoothness and skewness. Studies of one dimensional MHD wave propagation in the subsonic, sub-Alfvenic flow region in the solar corona and the propagation of finite amplitude disturbances in the supersonic, super-Alfvenic flow region of the solar wind are used to demonstrate the technique's accuracy and versatility. The adaptive grid method was used to study the propagation of solar generated disturbances through the solar wind critical points. The physical parameters of the steady state solar wind vary rapidly near the solar surface. The adaptive grid enables the circumvention of these difficulties by placing an extensive number of grid points near the solar surface and around the shock fronts. The method is shown to give a significant increase in accuracy and stability in the computation of this problem.
Dissert. Abstr.

**N88-19295#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**ELECTRON DENSITY PROFILE RECONSTRUCTION BY MAXIMUM ENTROPY METHOD WITH MULTICHANNEL HCN LASER INTERFEROMETER SYSTEM ON SPAC 7**
S. Kubo, K. Narihara, Y. Tomita, M. Hasegawa (Mitsubisi Electric Corp., Tokyo, Japan ), T. Tsuzuki, and A. Mohri Jan. 1988 35 p
(IPPJ-858; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

A multichannel HCN laser interferometer system has been developed to investigate the plasma electron confinement properties in a SPAC 7 device. The maximum entropy method is applied to reconstruct the electron density profile from measured line integrated data. Particle diffusion coefficient in the peripheral region of the REB ring core spherator was obtained from the evolution of the density profile. Author

**N88-19296#** Oak Ridge National Lab., Tenn.
**PROBLEMS IN MODELING TF RIPPLE LOSS OF FAST ALPHAS FROM A TOKAMAK REACTOR**
L. M. Hively 1987 14 p Presented at the Workshop on Alpha Particle Effects in ETR, Washington, D.C., 15 Jun. 1987
(Contract DE-AC05-84OR-21400)
(DE88-000612; CONF-8706119-2-FP) Avail: NTIS HC A03/MF A01

The present status of modeling TF ripple loss of fast alphas from tokamaks is summarized. The modeling issues are discussed, and several new aspects of this problem are described, including gyromotion, radial electric field, and sawtoothing. Existing models predict that TF ripple loss of fast alphas will have a low-to-moderate impact on the design of a tokamak engineering test reactor (ETR). DOE

**N88-19297#** Oak Ridge National Lab., Tenn.
**POTENTIAL BENEFITS OF A BROAD MAGNETIC FUSION R AND D PROGRAM**
J. Sheffield 19 Nov. 1987 19 p Presented at the Magnetic Fusion in Energy Policy Conference, Princeton, N.J., 19 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003288; CONF-8711145-1) Avail: NTIS HC A03/MF A01

This paper contains viewgraphs on the historical aspects, past benefits, and future needs of a broad magnetic fusion research program. All of the major types of magnetic confinement configurations are discussed. DOE

**N88-19296#** Department of Energy, Washington, D. C. Applied Plasma Physics Div.
**SUMMARIES OF FY86 RESEARCH IN THE APPLIED PLASMA PHYSICS FUSION THEORY PROGRAM**
Dec. 1987 157 p
(DE88-004242; DOE/ER-0356) Avail: NTIS HC A08/MF A01

The Theory Program is charged with supporting the development of theories and models of plasmas for the fusion research effort. This work ranges from first-principles analysis of elementary plasma processes to empirical simulation of specific experiments. The Theory Program supports research by industrial contractors, US government laboratories, and universities. The university support also helps to fulfill the DOE mission of training scientists for the fusion program. The Theory Program is funded through the Fusion Theory Branch, Division of Applied Plasma Physics in the Office of Fusion Energy. The work is divided among 31 institutions, of which 19 are universities, five are industrial contractors, and seven are U.S. government laboratories; see Table 1 for a complete list. The FY86 Theory Program budget was divided among theory types: toroidal, mirror, alternate concept, generic, and atomic. Device modeling is included among the other funding categories, and is not budgeted separately. DOE

**N88-19299#** Oak Ridge National Lab., Tenn.
**PROCEEDINGS OF US-JAPAN HELIOTRON-STELLARATOR WORKSHOP, VOLUME 3**
1987 339 p Workshop held in Oak Ridge, Tenn., 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004788; CONF-871179-Vol-3) Avail: NTIS HC A15/MF A01

This paper is the third of four volumes on the US-Japan Heliotron-Stellarator Workshop. It contains talks on the following: Heliotron EICRF Heating Experiment; CHS Heating Systems (NBI, ECH, ICH); ICH Program for ATF; ICRF Wave Propagation; the HBQM Heliac Work; configuration studies; compact torsatron studies; low aspect ratio torsatron design; optimized small stellarator designs; configuration studies for ATF; currents in ATF; currents in ATF; computations of 3-D equilibria with islands; magnetic surface mapping studies; magnetic field alignment and mapping on ATF; divertor experiments in IMS; PMI program and wall conditioning for ATF; hard X-ray suppression on ATF; plasma rotation and potential measurement; and status of heavy ion beam probe for ATF. DOE

**N88-19300#** Oak Ridge National Lab., Tenn.
**PROCEEDINGS OF US-JAPAN HELIOTRON-STELLARATOR WORKSHOP, VOLUME 2**
1987 312 p Workshop held in Oak Ridge, Tenn., 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004789; CONF-871179-Vol-2) Avail: NTIS HC A14/MF A01

This paper is the second of four volumes on the US-Japan Heliotron-Stellarator workshop. It contains talks on the following: Ripple Transport at Arbitrary Collision Frequency, Transport Scaling in the Collisionless-Detrapping Regime, Transport Analysis for Heliotron E, Transport Analysis for ATF, Simulation Analysis of Heating and Transport, Analysis of W VII-A Data, Numerical Study of Fast Ion Confinement, Benchmarks of NBI Codes for Stellarators, ECH Commissioning and Plans for ATF, and ECH and ICH Startup Analysis. DOE

**N88-19301#** California Univ., Berkeley. Lawrence Berkeley Lab.
**A NEUTRAL-BEAM DIAGNOSTIC FOR FAST CONFINED ALPHA PARTICLES IN A BURNING PLASMA: APPLICATOIN ON CIT (COMPACT IGNITION TOKAMAK)**
A. S. Schlachter, J. W. Stearns, and W. S. Cooper Oct. 1987 51 p
(Contract DE-AC03-76SF-00098)
(DE88-004890; LBL-24235) Avail: NTIS HC A04/MF A01

Diagnostic methods for fast confined alpha particles are essential for a burning-plasma experiment. We review one- and two-electron-capture methods using energetic neutral beams, and provide quantitative estimates of signal level for a two-electron-capture method applicable to CIT. The best probe is a ground-state helium-atom beam because of its relatively good penetration into a CIT plasma and the large cross section for two-electron capture; it can be produced in useful quantities from HeH(+). We calculate a signal level of the order of 10 to the 7th power counts for 100 mA of accelerated HeH(+), which is sufficient to allow time-resolved measurements of the alpha-particle velocity distribution. Limited position information could be obtained for appropriate access port geometry. This diagnostic is feasible, and we recommend further research and development leading to implementation on CIT. DOE

# 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

**N88-19302#** Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
**SINGLE-CRYSTAL STRUCTURAL STUDY OF La2Cu/SUB 0.95/Li/SUB 0.05/O4**
J. M. Delgado, R. K. McMullan, G. DiazdeDelgado (Brandeis Univ., Waltham, Mass.), J. S. Speck, and B. J. Wuensch 1987 7 p Presented at the Symposium on High Temperature Superconductors, Boston, Mass., 30 Nov. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003482; BNL-40538; CONF-8711114-2) Avail: NTIS HC A02/MF A01

A large crystal of flux-grown La sub 2 CuO sub 4, examined through single-crystal neutron diffraction, was found to have an orthorhombic superstructure. The pattern of systematically absent intensities indicated space group Pccn but meaningful refinement of thermal vibration parameters could not be obtained in this symmetry. Systematic examination of all possible orthorhombic subgroups of Fmmm yielded satisfactory refinement to $R(F^2)$ = 2.57 percent only in space group Bmab. Incorporation in the crystal of Li derived from the flux results in an orthorhombic distortion smaller than found for pure La sub 2 CuO sub 4. Refinement of the Cu site occupancy provided Cu sub 0.950 Li sub 0.050(3), in excellent accord with a bulk chemical analysis. Reflections which violate the systematic absences of Bmab are attributed to a smaller volume fraction of domains in orientation twinned by 90 degrees rotation about c. This interpretation is supported by transmission electron microscopy which revealed intergrown lamellae. Dark field imaging with a forbidden reflection illuminated only the twin lamellae. DOE

**N88-19303#** California Univ., Berkeley. Lawrence Berkeley Lab.
**SILICON AND INDIUM DOPING OF GaAs: MEASUREMENTS OF THE EFFECT OF DOPING ON MECHANICAL BEHAVIOR AND RELATION WITH DISLOCATION FORMATION**
E. D. Bourret, M. G. Tabache, A. G. Elliot, J. W. Beeman, and M. Scott Jun. 1987 23 p Presented at the American Conference on Crystal Growth, Monterey, Calif., 13 Jul. 1987 Prepared in cooperation with Hewlett-Packard Corp., San Jose, Calif. and Hewlett-Packard Corp., Palo Alto, Calif.
(Contract DE-AC03-76SF-00098)
(DE88-003862; LBL-22901; CONF-870799-4) Avail: NTIS HC A03/MF A01

The effect of indium and silicon doping on dislocation formation in GaAs single crystals has been studied experimentally using dynamic compression tests and indentation rosettes. By direct measurements of the critical resolved shear stress (CRSS) in temperature range from 400 to 1100 C using dynamic compression tests, we found that the critical resolved shear stress of GaAs:In is twice that of undoped GaAs. More recent measurements show that the critical resolved shear stress of silicon-doped crystals is lower than that of undoped GaAs. Well-defined indentation rosettes were obtained at high temperatures from a Vickers indenter using

small loads. Analysis confirm that the mechanical behavior of the GaAs crystals is not drastically affected by the presence of dopants. Reduction of dislocation densities in doped crystals is attributed to modifications introduced by the dopant in the equilibrium concentration of native defects at the melting point (particularly gallium and arsenic vacancies). DOE

**N88-19304#** California Univ., Berkeley. Lawrence Berkeley Lab.
**STRUCTURAL CHARACTERIZATION OF UNDOPED AND DOPED GaAs: A COMPARATIVE STUDY OF FOUR TECHNIQUES**
E. D. Bourret, A. G. Elliot, B. T. Lee, and J. M. Jaklevic Jun. 1987 15 p Presented at the International Symposium on Defect Recognition and Image Processing in 3-5 Compounds (DRIP 2), Monterey, Calif., 27 Apr. 1987 Prepared in cooperation with Hewlett-Packard Corp., San Jose, Calif.
(Contract DE-AC03-76SF-00098)
(DE88-004552; LBL-22698; CONF-8704248-1) Avail: NTIS HC A03/MF A01

Dislocations, striations and microprecipitates have been imaged in undoped and doped GaAs single crystals using four different techniques: chemical photoetching, synchrotron radiation topography, photoluminescence microscopy and electron microscopy. A comparison of the features observed by these techniques is presented. Photoetching was found to be the most sensitive technique to reveal electrically active structural defects specifically in cases where these defects do not produce significant lattice strain or do not act as recombination centers. DOE

**N88-19305#** Arizona State Univ., Tempe. Semiconductor Materials Research Lab.
**AUTONOMOUS LIQUID ENCAPSULATED CZOCHRALSKI (LEC) GROWTH OF SINGLE CRYSTAL GaAs BY INTELLIGENT DIGITAL CONTROL**
Karl Reidling and G. H. Schwuttke 19 Aug. 1987 42 p
(Contract F49620-86-C-0012; ARPA Order-9099)
(AD-A187211; AFOSR-87-1500TR) Avail: NTIS HC A03/MF A01 CSCL 12E

Virtually total automation of the high-pressure LEC process for GaAs growth could be achieved with an intelligent growth control approach which combines deterministic and heuristic techniques. A number of 4 kg, 3 inch semi-insulating GaAs crystals have been grown reproducibly on an adapted Cambridge Instruments CI 358 puller without any significant operator intervention; even complex process steps like seeding and tail-off could be successfully handled by the system on its own. Process yields of more than 75 percent single crystals could be accomplished. Crystals grown with the digital system were superior in uniformity and diameter control, compared to conventionally grown crystals. GRA

**N88-19306#** University of Southern California, Los Angeles. Dept. of Materials Science.
**THEORETICAL STUDIES OF THE INTERFACE ELECTRONIC PROPERTIES OF TETRAHEDRALLY COORDINATED SEMICONDUCTORS Final Report, 1 Jun. 1977 - 31 Dec. 1985**
Anupam Madhukar 29 Sep. 1987 51 p
(Contract N00014-77-C-0397)
(AD-A187216) Avail: NTIS HC A04/MF A01 CSCL 20L

The work covers the following subject areas: (1) Electronic Structure of Superlattices; (2) Electronic transport, magnetotransport, and magneto optical properties of quasi two dimensionally (2D) confined single particle states and charge carriers; (3) Collective properties of 2D electrons and holes; (4) Point Defect Inducted Deep levels in bulk compound semiconductors and superlattices; (5) The nature of Si/SiO2 system and the role of interface disorder; (6) Semiconductor/Metal Systems, including the Si/Silicide interface; (7) Spectroscopic Ellipsometry Studies; (8) Nitridation Kinetics of SiO2 on Si(100); (9) Computer Simulations of molecular beam epitaxial growth of compound semiconductors and the atomistic nature of interfaces. GRA

**N88-19307#** Chicago Univ., Ill. Dept. of Physics.
**MBE (MOLECULAR BEAM EPITAXIAL) GROWTH CHARACTERIZATION AND ELECTRONIC DEVICE PROCESSING OF HgCdTe, HgZnTe RELATED HETEROJUNCTIONS AND HgCdTe-CdTe SUPERLATTICES Quarterly Report**
Jean-Pierre Faurie 15 Jun. 1987 24 p
(Contract F49620-87-C-0021)
(AD-A187416; AFOSR-87-1629TR) Avail: NTIS HC A03/MF A01 CSCL 20B

As the MBE growth technique has continued to improve for Hg(1-x)Cd(x)Te films, the prospects for films of larger area have begun to be explored. These larger area films are important for imaging arrays and will be especially vital in the future for the efficient production of Hg(1-x)Cd(x)Te material. The growth of MBE of uniform Hg(1-x)Cd(x)Te epilayer on a large substrate is very difficult to achieve because of the non-uniform distribution of the fluxes and on the non-uniform temperature of the substrate. GRA

**N88-19308#** Colorado State Univ., Fort Collins.
**HIGH PRESSURE ELECTRONIC TRANSPORT IN SEMICONDUCTORS Final Report**
Ian L. Spain and James R. Sites Sep. 1987 12 p
(Contract DAAG29-84-K-0049)
(AD-A187428; ARO-20805.7-PH) Avail: NTIS HC A03/MF A01 CSCL 20L

Research has resulted in: (1) developing galvanomagnetic measurements on the diamond anvil and/or sapphire anvil cells to pressure of about 10 gPa, (2) performing electrical resistivity, magnetoresistance, Hall effect, and Shubnikov-de Haas measurements on bulk samples of GaAs and InP, and (3) carrying out I-V and C-V measurements on Schottky diodes of GaAs and InP and MIS Structures. GRA

**N88-19309#** Duke Univ., Durham, N. C. Dept. of Chemistry.
**THE FIRST GALLIUM-ARSENIC COMPOUND CONTAINING A SINGLE Ga3As UNIT: ISOLATION AND CRYSTAL STRUCTURE OF ((thf)Br2Ga)3As (thf = TETRAHYDROFURAN)**
Richard L. Wells, Soheila Shafieezad, Andrew T. McPhail, and Colin G. Pitt 28 Oct. 1987 10 p
(Contract N00014-83-K-0572)
(AD-A187457) Avail: NTIS HC A02/MF A01 CSCL 07B

Prior to 1986, there were no published examples of gallium-arsenic compounds containing a single As3Ga or Ga3A unit. However, during that year two compounds of the first type having three coordinate Ga and three coordinate As were reported, (R2As)3Ga(R=Mes(1)Bu(+2)). We now report the isolation and structure of a compound of the second type having, in this initial case, four-coordinate Ga and three- coordinate As, (thf) Br Ga As (thf = tetrahydrofuran) (1). The reaction of (Me3Si)3As3 with GaBr3, which affords the (Br2Ga)3As species found in (1), appears to be the first reported of a tri (silyl) arsine being utilized to form the Ga As linkage, and it further demonstrates the importance of silylarsines in the area of preparative gallium arsenic chemistry. GRA

**N88-19310#** Colorado Univ., Boulder.
**LASER MEASUREMENTS OF STATE-RESOLVED Ga AND IN ATOM STICKING AND DESORPTION ON METAL AND SEMICONDUCTOR SURFACES Annual Report, 1 Dec. 1986 - 30 Nov. 1987**
Stephen R. Leone 1 Dec. 1987 9 p
(Grant AF-AFOSR-0119-87)
(AD-A187644; AFOSR-87-1925TR) Avail: NTIS HC A02/MF A01 CSCL 20B

Work is carried out on the dynamics of Ga and As scattering, sticking, and desorption from silicon single crystals using laser probing of the Ga and As (dimer) gas phase species. In the last six months, results have been obtained for the binding energy of Ga on silicon. Structural patterns of Ga on silicon at various coverages have been determined by LEED studies. Results have been obtained for the desorption of two different Ga spin-orbit

states and a model developed to explain the observed behavior. The desorption pre-exponential factors suggest a one-dimensional mobility of Ga on silicon. These results are relevant to the epitaxial growth of GaAs on silicon. GRA

**N88-19311#** California Inst. of Tech., Pasadena. Dept. of Applied Physics.
**THE PHYSICS OF VERY SMALL STRUCTURES Final Technical Report, 30 Sep. 1982 - 30 Sep. 1985**
T. C. McGill 1987 63 p
(Contract N00014-K-82-0556)
(AD-A187672) Avail: NTIS HC A04/MF A01 CSCL 20C

Studies of the basic properties of small structures that could be of major importance in the fabrication of new microdevices have been carried out. Some of the basic areas of major contribution include: electron tunneling, transport over and through barrier structures, ohmic contacts and fluctuations, band offsets, and the search for lattice matches between silicides and silicon for application in microdevices. GRA

**N88-19312#** Ceramic Process Systems Corp., Cambridge, Mass.
**COMPOSITE CERAMIC SUPERCONDUCTING FILAMENTS FOR SUPERCONDUCTING CABLE Interim Progress Report, 16 Aug. - 15 Oct. 1987**
John W. Halloran 13 Nov. 1987 45 p
(Contract N00014-87-C-0789; ARPA Order 6214)
(AD-A187833) Avail: NTIS HC A03/MF A01 CSCL 13H

This is the first progress report of a five month program to demonstrate the feasibility of manufacturing superconducting wires from YBa2Cu3O7-x, consisting of a small ceramic core with a copper cladding. The critical current will be enhanced by creating a fiber texture in the ceramic using a combination of green particle orientation and controlled recrystallization. The ceramic core will be manufactured by solution dry-spinning of a mixture of the superconducting ceramic powder with appropriately chosen polymers, solvents, and additives. The dry-spun fibers will be sintered and then clad with copper or other metals by electroplating, or mechanical cladding. The objectives of the program are to demonstrate the dry spinning process, the sintering, and the cladding process, and to determine the effect of microstructural texturing on the critical current. The electrical and physical properties of the filaments are to be characterized. The process for synthesizing YBa2Cu3O7-x from copper oxide, yttrium oxide, and barium carbonate has been scaled up and improved. Problems involving retention of the barium carbonate have been overcome, and a sinterable powder is prepared after a single calcination reaction at 800 C. The powder readily sinters to around 94 percent theoretical density. GRA

**N88-19313#** Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
**INVESTIGATION OF DEFECT AND ELECTRONIC INTERACTIONS ASSOCIATED WITH GaAs DEVICE PROCESSING Annual Report, 16 Aug. 1986 - 15 Aug. 1987**
Harry C. Gatos and Jacek Lagowski Aug. 1987 25 p
(Grant AF AFOSR-0342-86)
(AD-A188021; AFOSR-87-1906TR) Avail: NTIS HC A03/MF A01 CSCL 07B

Research on new semi-insulating behaviour in 3-5 compounds completed the determination of electronic levels and related optical properties of substitutional titanium in bulk grown InP and GaAs. In the course of the corresponding crystal growth study we have also identified impurity gettering by transition elements. This gettering takes place due to melt (or solution), and it can be beneficial or detrimental for obtaining SI materials. An example of the beneficial role is provided by the interaction of vanadium with silicon, which reduces Si donor concentration in the grown crystal. An example of detrimental effect is provided by the interaction of titanium with carbon, which reduces the concentration of deep compensating Ti donors in epitaxial or melt grown crystals. Appropriate redesign of the epitaxial growth cell (eliminating all graphite elements in contact with the solution) is in progress. An investigation has been carried out on the extension of liquid phase electroepitaxy to the growth of bulk InGaAs crystals. We have successfully developed procedures for the electroepitaxial growth of InGaAs ingots 14 mm in diameter and up to 3 mm thick. To our knowledge, these are the first bulk InGaAs crystals to show excellent compositional uniformity (in accord with theoretical predictions for electroepitaxy). GRA

**N88-19314#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**PLASMA DEPOSITION OF SILICON CARBIDE THIN FILMS Final Report, 1 Jul. 1984 - 31 Jul. 1987**
W. D. Partlow, W. J. Choyke, John T. Yates, Jr., L. E. Kline, and M. J. Bozack 20 Aug. 1987 81 p
(Contract F49620-84-C-0063)
(AD-A188093; Rept-87-9C7-OPSIC-R1; AFOSR-87-1693TR)
Avail: NTIS HC A05/MF A01 CSCL 20L

This report summarizes the work performed on a three year program to obtain an understanding of deposition processes of thin films from plasmas. Deposition plasmas of methane and of methane-hydrogen and methane-silane mixtures were characterized via electrical, optical, and mass spectroscopic measurements. Surface chemical studies of the fundamental surface reactions were performed, and a model was constructed which takes into account both gas phase and the surface processes leading to deposition. The properties of the deposited films were related to the plasma conditions associated with their deposition. Advances in process modeling and surface chemical techniques were achieved on this program, in addition to the knowledge that was gained about the specific plasma deposition processes that were studied. GRA

**N88-19315#** Brown Univ., Providence, R. I. Dept. of Chemistry.
**PREPARATION AND CHARACTERIZATION OF Cu2Zn1-xMnxGeS4**
E. Honig, H. S. Shen, G. Q. Qao, K. Doverspike, and R. Kershaw 10 Nov. 1987 10 p
(Contract N00014-85-C-0177; Grant NSF DMR-86-01345)
(AD-A188113; TR-5) Avail: NTIS HC A02/MF A01 CSCL 20B

Single crystals of Cu2Zn1-xMnxGeS4 (x = 0, 0.3, 0.05, 0.10, 1.0) have been grown by chemical vapor transport. These crystallize with the wurtz-stannite structure. Magnetic measurements show that the Curie-Weiss law is obeyed. Manganese exhibits the expected spin only moment and the Weiss constants become more negative as the manganese concentration increases. Ambient temperature resistivities decrease with increasing manganese concentration. Two band transitions are observed for all materials in the range 1.9 = 2.1 eV. GRA

**N88-19316#** Notre Dame Univ., Ind. Dept. of Physics.
**VIBRATIONAL, MECHANICAL AND THERMAL PROPERTIES OF 3-5 SEMICONDUCTORS Annual Report, 1 Sep. 1986 - 31 Aug. 1987**
John D. Dow, R. V. Kasowski, and M. H. Tsai 29 Sep. 1987 12 p Prepared in cooperation with Du Pont de Nemours (E. I.) and Co., Wilmington, Del.
(Grant AF AFOSR-0331-85)
(AD-A187569; AFOSR-87-1585TR) Avail: NTIS HC A03/MF A01 CSCL 20L

Theories of the mechanical, vibrational, and electronic properties of 3 to 5 semiconductors have been developed and applied to: (1) help determine the feasibility of InN-based visible and ultraviolet lasers and light detectors, (2) develop a theory of phonons in semiconductor alloys, (3) elaborate on the physics of photoelasticity, (4) understand surface reconstruction of semiconductors, and (5) predict the effects of atomic correlations on the light scattering (Raman) properties of semiconductor alloys. Author

**N88-19317#** Pennsylvania State Univ., State College. Applied Research Lab.
**POINT DEFECT STRUCTURE OF Cr2O3 Ph.D. Thesis**

M. Y. Su and G. Simkovich Oct. 1987 167 p
(Contract N00024-85-C-6041)
(AD-A187620; ARL/PSU-TR-87-008) Avail: NTIS HC A08/MF A01 CSCL 20L

Chromium oxide, Cr2O3 is of considerable technological importance because it provides a protective scale on important materials, such as stainless steels and superalloys; therefore, it is of interest to know its transport properties and how these properties may be altered. In order to obtain a better understanding of the defect structure of Cr2O3, the electrical conductivity and Seebeck coefficient of sintered high purity Cr2O3, titanium oxide, TiO2-doped Cr2O3, and magnesium oxide MgO-doped Cr2O3 have been measured as functions of temperature, oxygen partial pressure and different levels of dopant content. Results from these measurements show that the defect structure of Cr2O3 is relatively complicated. At high temperatures, depending upon the oxygen partial pressure different defects may present. In general, at high phosphorus oxide, PO2, Cr2O3 is a P-type semiconductor with electron holes and chromium vacancies as the predominant defects; at intermediate PO2, Cr2O3 behaves as an intrinsic semiconductor with electron and electron holes as the major defects; at low PO2, Cr2O3 changes to an N-type semiconductor with electrons and chromium interstitials as the dominant defects. GRA

**N88-19318*#** Alabama Univ., Huntsville. School of Mathematics and Natural Sciences.
**MCT CRYSTAL GROWTH Final Report**
James K. Baird 23 Feb. 1988 23 p
(Contract NAS8-34957)
(NASA-CR-179297; NAS 1.26:179297) Avail: NTIS HC A03/MF A01 CSCL 20L

Convection and segregation in directional solidification and crystal growth by the Bridgman-Stockbarger technique are traditionally treated by assuming axisymmetric thermal condition on the ampoule wall. It is, however, difficult to achieve such a condition in an experimental setup. Any deviation from an axisymmetric temperature field on the wall of a vertical ampoule represents a horizontal temperature gradient. The horizontal density gradient that results from thermal expansion in the melt under this condition must lead on earth to some buoyance-driven convection, no matter what the axial (vertical) temperature distribution that is imposed on the melt. The magnitude of such convective flows for conditions representative of the MSFC mercury-cadmium-telluride (MCT) Bridgman setup is studied. B.G.

**N88-19319*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**THEORETICAL STUDIES OF THE POTENTIAL SURFACE FOR THE F - H2 GREATER THAN HF + H REACTION**
Charles Bauschlicher, W., Jr., Stephen Walch, P., Stephen R. Langhoff, Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.), and Richard L. Jaffe [1987] 23 p
(Contract NCC2-371)
(NASA-CR-182551; NAS 1.26:182551) Avail: NTIS HC A03/MF A01 CSCL 20L

The F + H2 yields HF + H potential energy hypersurface was studied in the saddle point and entrance channel regions. Using a large (5s 5p 3d 2f 1g/4s 3p 2d) atomic natural orbital basis set, a classical barrier height of 1.86 kcal/mole was obtained at the CASSCF/multireference CI level (MRCI) after correcting for basis set superposition error and including a Davidson correction (+Q) for higher excitations. Based upon an analysis of the computed results, the true classical barrier is estimated to be about 1.4 kcal/mole. The location of the bottleneck on the lowest vibrationally adiabatic potential curve was also computed and the translational energy threshold determined from a one-dimensional tunneling calculation. Using the difference between the calculated and experimental threshold to adjust the classical barrier height on the computed surface yields a classical barrier in the range of 1.0 to 1.5 kcal/mole. Combining the results of the direct estimates of the classical barrier height with the empirical values obtained from the approximation calculations of the dynamical threshold, it is predicted that the true classical barrier height is 1.4 + or - 0.4 kcal/mole. Arguments are presented in favor of including the relatively large +Q correction obtained when nine electrons are correlated at the CASSCF/MRCI level. Author

**N88-19320*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SYMMETRY AND EQUIVALENCE RESTRICTIONS IN ELECTRONIC STRUCTURE CALCULATIONS**
Charles W. Bauschlicher, Jr. and Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.) [1988] 15 p
(Contract NCC2-371)
(NASA-TM-89252; NAS 1.15:89252) Avail: NTIS HC A03/MF A01 CSCL 20L

A simple method for obtaining MCSCF orbitals and CI natural orbitals adapted to degenerate point groups, with full symmetry and equivalnece restrictions, is described. Among several advantages accruing from this method are the ability to perform atomic SCF calculations on states for which the SCF energy expression cannot be written in terms of Coulomb and exchange integrals over real orbitals, and the generation of symmetry-adapted atomic natural orbitals for use in a recently proposed method for basis set contraction. Author

**N88-19321#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**PROCEEDINGS OF THE POLYCRYSTALLINE THIN FILM PROGRAM MEETING**
1987 203 p Meeting held in Lakewood, Colo., 20 Jul. 1987
(Contract DE-AC02-83CH-10093)
(DE87-001169; SERI/CP-211-3171; CONF-8707100) Avail: NTIS HC A10/MF A01

Cadmium telluride, copper selenide, INDIUM selenide, and cascade solar cells are all discussed in these proceedings on thin films. DOE

**N88-19322#** Pittsburgh Univ., Pa. Dept. of Materials Science and Engineering.
**ATOM PROBE MICROANALYSIS OF SUPERCONDUCTING YBa2Cu3O(SUB 7-x)**
S. S. Brenner and G. L. Kellogg 1987 5 p Presented at the Symposium on High Temperature Superconductors, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-003203; SAND-87-2773C; CONF-8711114-1) Avail: NTIS HC A02

Superconducting YBa2Cu3O(sub 7-x) needles prepared from hot-pressed discs of oxide powders were analyzed in a long drift-tube type atom probe. The analyses were made of randomly located areas about 2 nm in diameter. Most of the oxygen field-evaporated as O2(+)ions. The measured composition agreed well with the theoretical one expected of YBa2Cu3O(sub 6.5) except for yttrium which was found to be too high. The composition profiles showed concentration fluctuations about 2.5 nm apart which must still be clarified. DOE

**N88-19323#** Sandia National Labs., Albuquerque, N. Mex.
**FORMATION OF BURIED NITRIDE LAYERS IN (110) SILICON**
A. K. Datye, V. S. Kaushik, D. L. Kendall, B. Martinez-Tovar, and D. R. Myers 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract DE-AC04-76DP-00789)
(DE88-003255; SAND-87-1586C; CONF-871124-42) Avail: NTIS HC A02/MF A01

High fluence ion implantation of N(+) (1x10 to the 18th/sq cm at 150 keV) has been used to form buried nitride layers in (110) silicon. After annealing at 1200 C for 5 h, a continuous polycrystalline alpha-silicon nitride layer (200 nm thick) is observed beneath a surface silicon film 150 nm thick. The upper Si/Si3N4 interface appears to be more abrupt than that observed in (100)

silicon with minimal dendritic intergrowth and no evidence for microtwinning in the silicon. Furthermore, a bond of nitride precipitates can be detected 500 nm below the continuous nitride layer. These nitride precipitates grow semi-coherently within the silicon with no observable strain or misfit dislocations within the silicon. The nitride precipitates are internally faulted to accommodate the 10 percent lattice mismatch in the (0001) nitride direction. Short-term anneals reveal that the precipitates have fully crystallized within 10 min. at 1200 C while the continuous nitride layer is still amorphous. DOE

**N88-19324#** Pacific Northwest Labs., Richland, Wash.
**RAMAN ENHANCEMENT METHODS FOR MOLECULAR STRUCTURE CHARACTERIZATION OF OPTICAL THIN FILMS**
D. M. Friedrich and G. J. Exarhos Jun. 1987 31 p Presented at the International Conference on Metallurgical Coatings, San Diego, Calif., 23 Mar. 1987
(Contract DE-AC06-76RL-01830)
(DE88-003421; PNL-SA-14607; CONF-870388-16) Avail: NTIS HC A03/MF A01

Because of the low Raman scattering probability and the short optical paths in films and interfaces, several techniques to enhance Raman signals have been developed. Among these are interference enhancement in multilayer structures, path length extension by wave guide methods, coherent nonlinear Raman spectroscopies, and resonant Raman enhancement by the use of short wavelength excitation. We discuss the advantages and limitations of interference and resonance enhancement methods. A common theme of both methods is the measurement of a Raman excitation profile spectrum by tuning the probe laser wavelength across an optical interference passband or across the electronic bandgap of the film material. Although interference is an optical effect which enhances the Raman spectrum uniformly, under resonance Raman conditions selective enhancement is observed for vibrational modes which are strongly coupled to the allowed electronic transitions in the dielectric material. The principal limitation of resonance Raman probes of solid films is the optical damage threshold which is easily exceeded by typical UV pulsed probe power levels near the electronic band edge. DOE

**N88-19325#** Sandia National Labs., Albuquerque, N. Mex.
**AN ELECTRON SPECTROSCOPIC INVESTIGATION OF HIGH-TEMPERATURE SUPERCONDUCTING OXIDES**
J. W. Rogers, Jr. and D. S. Blair 1987 14 p Presented at the Thin Film Processing and Characterization of High Temperature Superconductors, Anaheim, Calif., 6 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003807; SAND-87-2273C; CONF-871178-3) Avail: NTIS HC A03/MF A01

High resolution X-ray Photoelectron and X-ray-excited Auger Electron Spectroscopy (XPS and XAES) have been used to study the electronic structure of La-Sr-Cu and Y-Ba-Cu superconducting oxide surfaces. The experiments were carried out on freshly cleaved (ex-situ) samples at room temperature and the results were compared with spectra obtained from Cu and CuO. The XPS Cu(2p) features show clearly that Cu (+2) (3d(9)) is present in the near surface region of both superconducting oxides and suggests that they are mixed valent containing both 3d (9) and 3d (10) contributions. No evidence for Cu (+3) (3d(8)) was found. XAES Cu(LMM) spectral features are consistent with the superposition of mixed valent Cu sites and the hole-hole interaction energies for the Cu(LMM) transitions, a direct experimental measurement of electron correlation in the Cu 3d levels, indicate strong electron correlation. DOE

**N88-19326#** Crystal Systems, Inc., Salem, Mass.
**GROWTH OF Cr,Nd:Gd3Sc2Al3O12 (Cr,Nd:GSAG) CRYSTALS BY THE HEAT EXCHANGER METHOD (HEM)(TRADEMARK) Final Report, 1 Dec. 1984 - 31 Mar. 1986**
C. P. Khattak, F. Schmid, and A. N. Scoville 31 Mar. 1987 36 p
(Contract W-7405-eng-48)
(DE88-004041; UCRL-15972; CSI-87-R-1004) Avail: NTIS HC A03/MF A01

The feasibility of growth of Cr,Nd:Gd3Sc2Al3O12 (Cr,Nd:GSAG) crystals by the Heat Exchanger Method (HEM) has been demonstrated. Core-free crystals of optical quality have been produced. Even with unseeded growth 2 cm diameter grains have been obtained. Procedures have been developed to minimize growth striations in the crystals. Secondary phases were formed during unseeded growth of large charges when growth was carried out under high temperature gradients. Procedures were developed to nucleate the stoichiometric phase and sustain this phase during growth. This can be achieved by seeded growth which is necessary to obtain oriented, large single crystals of Cr,Nd:GSAG. Spectroscopic measurements have shown extraneous absorption, which can be eliminated by post-growth annealing of crystals in an oxidizing atmosphere. This absorption is related with oxygen-vacancy related defects which are common in the mixed oxide crystals. It has been demonstrated that a development effort in producing Cr,Nd:GSAG crystals would lead to growth of large, optical quality crystals for laser applications. DOE

**N88-19327#** Lawrence Livermore National Lab., Calif.
**DEVELOPMENT ACTIVITIES FOR A 21-T SUPERCONDUCTING MAGNET AND CRYOSTAT Status Report**
J. R. Miller, J. A. Kerns, D. S. Slack, M. J. Strum, and L. T. Summers Dec. 1987 30 p
(Contract W-7405-eng-48)
(DE88-004370; UCID-21275) Avail: NTIS HC A03/MF A01

Development activities to date have emphasized the following areas: modifications to existing laboratory test equipment in preparation for an intensified test program in the next calendar year, development and fabrication of critical components for the He-II cryostats needed both for the test program and for the 21-T spectrometer cryostat, selection and characterization of insulation materials and impregnants, preparation of the mechanical analysis techniques, and characterization of pre-protypical conductors. Highlights include progress on fabrication of the model coil cryostat and the acquisition of illuminating mechanical data on both reacted and unreacted conductor samples. DOE

**N88-19328#** North Carolina Univ., Chapel Hill.
**ION BEAM MODIFICATION OF FILM STRESS AND THE EFFECTIVENESS OF THIN FILM ENCAPSULANTS ON GaAs**
T. E. Haynes, S. T. Picraux, S. R. Lee, and W. K. Chu 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-004458; SAND-87-2870C; CONF-871124-49) Avail: NTIS HC A02

Ion implantation has been used to modify the initial stress in thin (40 nm) SiO2 films on GaAs, and to condition the SiO2-GaAs interface to promote adhesion. The effectiveness of these implanted films as caps to suppress decomposition of GaAs during rapid thermal processing has been studied, and this provides an indicator of the mechanical stability of the films. Measurements of the initial film stress, as well as stress changes caused by implantation and annealing, have been made to help interpret the implantation results. Results indicate that ion implantation does not have a strong effect on the performance of thin film SiO2 encapsulants on GaAs. DOE

**N88-19329#** Sandia National Labs., Albuquerque, N. Mex.
**COMPARISON OF LOW TEMPERATURE PHOTOLUMINESCENCE OF BULK MBE (MOLECULAR BEAM EPITAXY) GROWN AlGaAs AND GaAs USING A GRAPHITE GENERATED DIMER VERSUS A STANDARD TETRAMER ARSENIC GROUP-V SOURCE**
Thomas M. Brennan, B. E. Hammons, M. C. Smith, and E. D. Jones 1987 11 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)

(DE88-004939; SAND-87-1598C; CONF-871124-57) Avail: NTIS HC A03/MF A01

The carbon concentrations in GaAs and AlGaAs grown by Molecular Beam Epitaxy (MBE) have been studied when a graphite generated dimeric arsenic species and a standard tetramer arsenic species are used as the group-V source. Photoluminescence and Van der Pauw-Hall measurements have been made to examine the material quality in reference to which arsenic species is used for film growth. Results indicate that a graphite crucible arrangement for the thermal cracking of As(4) produces significant carbon contamination and is unacceptable for the MBE growth of GaAs and AlGaAs. DOE

**N88-19330#** Pacific Northwest Labs., Richland, Wash.
**PROCESSING RELATIONSHIPS IN YBa2Cu3O(7-x) SUPERCONDUCTORS**
W. J. Weber, L. R. Pederson, G. D. Maupin, and E. J. LeBlanc Oct. 1987 5 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC06-76RL-01830)
(DE88-005137; PNL-SA-15380; CONF-871124-58) Avail: NTIS HC A02/MF A01

Samples of YBa sub 2 Cu sub 3 O sub 7-x were prepared by solid state reaction of Y sub 2 O sub 3, BaO sub 2, and CuO powders mixed in stoichiometric proportions. Powders reacted at 900 to 925 C in air were pressed at 35 MPa into rectangular bars and sintered at 950 C in air for six hours. Slow cooling at 50 C/hour promoted complete transformation to the orthorhombic structure. The effects of subsequent oxidation processing on superconducting properties were also investigated. Oxidation anneals at one atmosphere pressure in flowing O sub 2 over the temperature range from 300 to 550 C were performed. Results indicate that oxidation at 450 C optimized the superconducting transition temperature at 91K with a 2-degree transition width. Subsequent high-pressure oxidation (2000 psi O sub 2) at 200 C for one week significantly degraded the superconducting characteristics. Results based on iodometric titration measurements and thermogravimetric analysis suggest that the copper valency is about 2.3 and oxygen stoichiometry is 6.94 (x = 0.06) in samples processed to optimize superconducting properties. DOE

**N88-19331#** Pacific Northwest Labs., Richland, Wash.
**THE INFLUENCE OF PROCESSING VARIABLES ON PHYSICAL PROPERTIES OF SOL-GEL DERIVED TiO2 FILMS**
W. S. Frydrych, K. F. Ferris, and G. J. Exarhos Oct. 1987 7 p Presented at the Conference on Atomic and Molecular Processing of Electronic and Ceramic Materials: Preparation, Characterization and Properties, Seattle, Wash., 31 Aug. 1987
(Contract DE-AC06-76RL-01830)
(DE88-005155; PNL-SA-15182; CONF-870878-3) Avail: NTIS HC A02/MF A01

The nature of films deposited using sol-gel techniques depends upon the molecular structure of the solution, which is controlled by solution chemical equilibria and reaction kinetics. The influence of solution chemistry, solution reaction time, and thermal processing on the resulting phase of titania sol-gel films have been examined. Raman spectroscopy has been used to characterize the phase, phase homogeneity, and inherent stress in the films. An increased solution reaction time prior to film deposition was found to stabilize an amorphous TiO sub 2 phase to temperatures approaching 490 C. In addition, in situ time-resolved Raman spectroscopy has been used to examine the film crystallization process. DOE

**N88-19332#** Slovak Academy of Sciences, Bratislava (Czechoslovakia). Elektrotechnicky Ustav.
**PROCEEDINGS OF THE FIRST INTERNATIONAL SYMPOSIUM ON PHYSICAL AND TECHNICAL PROBLEMS OF SUPERCONDUCTIVITY APPLICATION IN POWER GENERATION**
1986 225 p In RUSSIAN Symposium held in Smolenice, Czechoslovakia, 22 Oct. 1985
(DE88-700818; INIS-mf-11076; CONF-8510484) Avail: NTIS (US Sales Only) HC A10/MF A01

The proceedings contain the introductory speech of the representative of the Electrotechnical Institute of the Slovak Academy of Sciences, the text of the recommendation adopted by the participants of the symposium, the symposium program, and the full texts of 24 of 39 papers submitted. These papers are classified into five areas, i.e., superconducting ac facilities, superconducting magnet systems, magnetic separation, superconducting materials, and electromagnetic and thermal properties of superconductors. DOE

**N88-19333#** Ustav Jaderneho Vyzumu, Rez (Czechoslovakia).
**STUDIES IN SOLID STATE IONICS**
D. Jakes and J. Rosenkranz Jan. 1987 21 p
(DE88-700830; UJV-7857-M) Avail: NTIS (US Sales Only) HC A03/MF A01

Studies performed over 10 years by the high temperature chemistry group are reviewed. Attention was paid to different aspects of ionic solids from the point of view of practical as well as theoretical needs of nuclear technology. Thus a ceramic fuel compound like uranates, the urania-thoria system, solid electrolytes based on oxides and ionics transformations were studied under reactor irradiation. DOE

**N88-19334#** Technical Research Centre of Finland, Espoo.
**ELECTROCHROMIC THIN FILMS**
C. Nyman, U. Gullenberg, and M. Leppihalme Jun. 1987 45 p In FINNISH
(DE88-751099; VTT-TIED-727) Avail: NTIS (US Sales Only) HC A03/MF A01

An electrochromic material has the property of changing color when voltage is applied across it. It is possible electronically to alter a window's transmission and reflection properties by use of electrochromic thin films. This allows regulation of conductive and radiative heat transfer rates, with variable optical attenuation in the visible and infrared part of the solar radiation. Suitable materials for electrochromic films are transition metal oxides, such as tungsten and molybdenum. In the study the theory of electrochromism, device technology and different materials and their applications are considered. Electrochromic thin films have been made on glass substrates to show the fabrication method. The films have been produced by dc-sputtering in different atmospheres. For energy efficient window shutters the important characteristics are solar-matched spectral response, low power, wide operating temperature and wide range of intensity response. Shutters should also be programmable and manually controlled according to heating and cooling needs and should withstand solar radiation, weather, and cleaning. Last of all, the fabrication of material needs to be cost effective. DOE

**N88-19335#** Radiotechnique-Compelec, Paris (France).
**DEVELOPMENT OF A MULTIPLEXER MODULE FOR USE IN A SPACEBORNE CRYOGENIC ENVIRONMENT BASED ON GaAs MESFET TECHNOLOGY Final Report**
A. FitzGerald (Borer Electronics A.G., Solothurn, Switzerland ) Paris, France ESA 1987 77 p Prepared for Borer Communications AG Prepared in cooperation with UKAEA, Harwell, England
(Contract ESTEC-6476/4/85-NL)
(RPT/CRY/62463/BOP; ESA-CR(P)-2450; ETN-88-91414)
Copyright Avail: NTIS HC A05/MF A01

A transistor for use in a cryogenic multiplexer was chosen, and cryogenic multiplexing devices were manufactured and tested. An N-ON transistor with 1.5 micron gate length was chosen as the best compromise between performance and reliability. With a width of 150 microns the transistor has a low enough ON resistance (channel resistance). The manufactured multiplexing devices have two 10:1 multiplexers on board, with 5 common control lines, packaged in a 28 pin DIL ceramic package. Tests show that the multiplexers are suitable for use in the proposed applications. For voltage at the channel under 0.3 V channel resistance is less than 300 ohms. Leakage currents are less than 5 nA in all cases. ESA

**N88-19336#** Technische Univ., Berlin (West Germany). Fachbereich Elektrotechnik.
**THE QUALITATIVE DETERMINATION OF HIGH INJECTION EFFECTS IN FLUX-LOADED P-I-N DIODES USING THE RECOMBINATION RADIATION MEASURING METHOD Ph.D. Thesis [UEBER DIE QUANTITATIVE ERFASSUNG DER HOCHINJEKTIONSEFFEKTE IN FLUSSBELASTETEN PIN-DIODEN MIT HILFE DER REKOMBINATIONSSTRAHLUNGS-MESSMETHODE]**
Christian Boit 1987 201 p In GERMAN
(ETN-88-91475) Avail: NTIS HC A10/MF A01

Recombination radiation measurements were performed on conducting P-I-N silicon diodes with a view to the quantitative analysis of the effects of strong charge carried injections. The ambipolar diffusion length as a function of the injected carrier density and the effect of carrier-carrier scattering were determined. The dependence of the effective lifetime in the base on the different parameters was obtained. The effect of the crystal surface on the recombination behavior of P-I-N diodes was determined. ESA

**N88-19337#** Royal Signals and Radar Establishment, Malvern (England).
**AUTOMATIC PROBER FOR THE dc CHARACTERIZATION OF GALLIUM ARSENIDE DEVICES. PART 1: THE MEASUREMENT FACILITY**
B. T. Hughes and B. E. Avery Jul. 1987 41 p
(AD-A187583; RSRE-Memo-4065-Pt-1; BR103718-Pt-1; ETN-88-91543) Copyright Avail: NTIS HC A03/MF A01 CSCL 20L

A computer controlled auto prober system was constructed to allow detailed information to be obtained from a large number of GaAs devices. The prober system consists of two separate facilities, one to carry out the dc measurements and the other to allow the data obtained to be analyzed and correlated. Both facilities were designed as an integrated system and offer a range of on-wafer measurements which include characterization of active devices such as GaAs MESFETs and Schottky diodes as well as measurement routines for use on various test patterns for assessing ohmic contacts and investigating doping profiles of device layers. Passive components such as on-wafer capacitors and resistors can be measured. The system is designed for nonexpert use. ESA

**N88-19338#** Royal Signals and Radar Establishment, Malvern (England).
**OPTICAL ABSORPTION IN DOPED CdxHg1-xTe**
R. G. Humphreys Aug. 1987 22 p
(AD-A187434; RSRE-Memo-4069; BR103380; ETN-88-91544) Copyright Avail: NTIS HC A03/MF A01 CSCL 20L

Temperature dependence of the absorption edge of CMT is discussed. The theory of optical absorption in heavily doped (degenerate) cadmium mercury telluride (CMT) is formulated to use measured band parameters. The absorption theory is compared with Anderson's (1980) approximation to Kane's (1957) k.p. theory. The differences are found to be small near threshold, due to a fortuitous cancellation of errors. The dispersion of the refractive index near the band gap is calculated. This has only a small effect on the calculated absorption, but could be of importance in modeling interference fringes in thin detectors. ESA

**N88-19339** New South Wales Univ., Sydney (Australia).
**GAS PHASE REACTIONS OF ELECTRONS, NEGATIVE IONS AND FREE-RADICALS WITH TRANSITION METAL COMPLEXES Abstract Only. Ph.D. Thesis**
Glen William Dillow Nov. 1986 209 p
Avail: Issuing Activity

Negative chemical ionization (NCI) mass spectrometry is used as a probe to examine the negative ion chemistry of metal coordination complexes in the gas phase. Reaction of metal complexes with electrons, nucleophiles, and free-radicals in several NCI plasmas are identified. The first phase details the characterization of (M + CnH2n)(-) and (M + CnH2n + 1)(-) (n=1-5) hydrocarbon adduct ions which are observed at m/z values above the molecular ion, (M)(-), in the methane NCI mass spectra of a variety of metal coordination complexes. In the second and major phase of the project, the reagent gases NF3, CF2Cl2, and CF3Br are used as negative channel chemical ionization reagent gases to generate high abundances of fluoride, chloride, and bromide ions respectively, and the gas phase negative ion chemistry of a variety of metal coordination complexes in the presence of these reagent gases is examined. The NCI mass spectra are reported for the zinc (II) complexes of acetylacetone and its fluorinated analogs, as well as the cobalt (II), nickel (II), copper (II), and zinc (II) complexes of acetylacetone, N,N'-ethylenebis (salicylimine), and meso-tetraphenylporphin. Evidence is presented for the occurrence of a variety of ion/molecule and free radical/molecule processes as well as resonance electron capture. Author

**N88-19340** New South Wales Univ., Sydney (Australia).
**ELECTRON PARAMAGNETIC RESONANCE STUDIES OF Mn(2+) IN 2-6 SEMICONDUCTOR ALLOYS Abstract Only. Ph.D. Thesis**
A. K. Koh 1986 254 p
Avail: Issuing Activity

The aim was to use electron paramagnetic resonance measurements of Mn(2+) to add to knowledge of the properties of Mn in a semiconductor alloy environment. The Mn(2+) was studied in low concentrations (x less than or equal to 0.001) and in materials such as Hg(1-x)CdxTe. Most of the information was obtained from the hyperfine interaction constant A and axial zero-field splitting D in various polycrystalline samples. One of the most important results was that D is less than or equal to 1/0.14/cm which is comparable to D in hexagonal semiconductors. The present measurements of D have led to a revision of the model for the specific heat of the semimagnetic semiconductors since previous models had been based on a larger value of D. The second major results has been the determination of the variation of A and D with composition for all alloys studied. For the case of alloys containing Hg, a step variation in A was observed at the same concentration as the maximum value of D which did not occur at x=0.5 for these cases. In order to explain these effects, a new theory of the systematic variation of A and D in 2-6 semiconductors was proposed based on a reinterpretation of the effect of the Szigeti charge and recent EXAFS results on alloys. Author

**N88-19341** New South Wales Univ., Sydney (Australia).
**MICROELECTRONIC APPLICATIONS OF THE CONDUCTOR-THIN INSULATOR-SEMICONDUCTOR (CIS) STRUCTURE Abstract Only. Ph.D. Thesis**
Mohammad Kazem Moravvej-Farshi Dec. 1986 171 p
Avail: Issuing Activity

Selected applications of both minority and majority carrier conductor-thin insulator-semiconductor (CIS) tunnel structures to microelectronic devices such as bipolar and field-effect transistors are studied. By replacing the normally diffused emitters of silicon bipolar transistors with metallic conductor CIS heterojunction tunneling emitters, significant improvements in the current gain and in the breakdown voltage of super gain silicon bipolar transistors have been obtained. The emitter of a newly proposed transistor structure, the bipolar inversion-channel field-effect transistor (BICFET), is replaced by a majority carrier CIS tunnel emitter. Both Al and n(+) poly have been used as the conductor overlying the tunnel insulator. In the latter case, where a self-aligned scheme is implemented, a good quality interfacial oxide is shown to have an essential role in device operation. The shallow junction depth of the minority carrier CIS structures has been used to advantage by replacing the normally diffused source and drain regions of a MOSFET with such structures. This has enabled a novel metal gate NMOS transistor with near-zero depth source and drain junctions to be fabricated. Finally, a novel self-alignment scheme which is particularly suitable for very short channel MOSFETs with CIS source and drain junctions is incorporated by interposing a polysilicon gate between these regions. A deliberately

grown interfacial oxide is shown to suppress short-channel effects in the shortest channel devices studied. Author

**N88-19342** New South Wales Univ., Kensington (Australia).
**HIGH DENSITY CMOS TECHNOLOGY Abstract Only. M.S. Thesis**
Kumudini A. Nanayakkara Feb. 1986 222 p
Avail: Issuing Activity

Trends in CMOS VLSI are towards increasing process complexity and cost, as device spacings are reduced. The potential of low-voltage operation to relieve these problems is investigated. In order to reduce the risk of latch-up in CMOS circuits, the maximum value of the supply voltage is set by the holding voltage of the parasitic pnpn structure. The performance degradation that occurs due to low-voltage operation is investigated. The advantages of low-voltage operation which are described include: low power dissipation; simplified process compared with prevailing methods of increasing latch immunity; and prevention of degradation due to high fields. The experimental research was devoted to the following technologies: developing an optimum photoresist technology, with positive photoresist being able to yield feature sizes of 1 micron; developing a lift-off patterning procedure for aluminum, with a minimum feature size of 1.1 micron; and growth of channel oxides in the range of 30 to 50 nm. A 1 micron NMOS transistor was fabricated and tested. A structure was designed and fabricated to obtain data on the parasitic devices in latch-up. Author

**N88-19343*#** TRW Space Technology Labs., Redondo Beach, Calif. Applied Technology Div.
**FEASIBILITY STUDIES OF THE GROWTH OF 3-5 COMPOUNDS OF BORON BY MOCVD Final Report**
H. M. Manasevit Mar. 1988 35 p
(Contract NAS1-18373)
(NASA-CR-181622; NAS 1.26:181622; SN-48565/51441) Avail: NTIS HC A03/MF A01 CSCL 20L

Boron-arsenic and boron-phosphorus films have been grown on Si sapphire and silicon-on-sapphire (SOS) by pyrolyzing Group 3 alkyls of boron, i.e., trimethylborane (TMB) and triethylborane (TEB), in the presence of AsH3 and PH3, respectively, in an H2 atmosphere. No evidence for reaction between the alkyls and the hydrides on mixing at room temperature was found. However, the films were predominantly amorphous. The film growth rate was found to depend on the concentration of alkyl boron compound and was essentially constant when TEB and AsH3 were pyrolyzed over the temperature range 550 C to 900 C. The films were found to contain mainly carbon impurities (the amount varying with growth temperature), some oxygen, and were highly stressed and bowed on Si substrates, with some crazing evident in thin (2 micron) B-P and thick (5 micron) B-As films. The carbon level was generally higher in films grown using TEB as the boron source. Films grown from PH3 and TMB showed a higher carbon content than those grown from AsH3 and TMB. Based on their B/As and B/P ratios, films with nominal compositions B sub12-16 As2 and B sub1.1-1.3 P were grown using TMB as the boron source. Author

**N88-19344#** National Academy of Sciences - National Research Council, Washington, D. C.
**RESEARCH BRIEFING ON HIGH-TEMPERATURE SUPERCONDUCTIVITY**
Oct. 1987 32 p
(Grant NSF LPA-85-01382)
(PB88-133004) Avail: NTIS HC A03/MF A01 CSCL 20L

The research briefing was prepared in response to the exciting developments in superconductivity in ceramic oxide materials announced earlier in 1987. The panel's specific charge was to examine not only the scientific opportunities in high-temperature superconductivity but also the barriers to commercial exploitation. While the base of experimental knowledge on the superconductors is growing rapidly, there is as yet no generally accepted theoretical explanation of their behavior. The fabrication and processing challenges presented by the materials suggest that the period or precommercial exploration for applications will probably extend for a decade or more. Near term prospects for applications include magnetic shielding, the voltage standard, superconducting quantum interference devices, infrared sensors, microwave devices, and analog signal processing. The panel also identified a number of longer-term prospects in high-field and large-scale applications, and in electronics. The United States' competitive position in the field is discussed, major scientific and technological objectives for research and development identified, and concludes with a series of recommendations. GRA

**N88-19345#** Foersvarets Forskingsanstalt, Stockholm (Sweden).
**INVESTIGATION OF THE EQUIVALENT CIRCUIT AND CARRIER LIFETIMES OF SI/SIGe HETEROSTRUCTURE P-N DIODES FOR FREQUENCIES BETWEEN 0.5 AND 18.5 MHz**
L. Ahlfors, S. Rudner, and M. Willander Sep. 1987 39 p
(PB88-138201; FOA-C-30469-3.2) Avail: NTIS HC A03/MF A01 CSCL 20L

The use of semiconductor heterostructures and heterojunctions today plays an important part in the development of superior electronic devices. Recently much interest was focused on Si(x)Ge(1-x)/Si junctions. Such a structure, doped as a P-N junction, was investigated. A method was developed for measuring the lifetime of minority carriers in such structures. The method uses an Automatic Network Analyzer (ANA) in combination with computer modeling. As a result of these measurements, the lower limit of the lifetime was determined for holes in a thin layer of Si(0.9)Ge(0.1) to 0.80 plus or minus 0.53 microseconds. GRA

**N88-19346#** Brookhaven National Lab., Upton, N. Y.
**THE STATUS OF R AND D FOR SUPERCONDUCTING POWER TRANSMISSION SYSTEMS**
E. B. Forsyth 1987 10 p Presented at the Workshop on Utility Applications of Superconductivity, Washington, D.C., 22 Oct. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003499; BNL-40420; CONF-8710244-1) Avail: NTIS HC A02/MF A01

Many research groups in the US, Europe and the USSR worked on the development of superconducting power transmission systems in 1960's, 1970's and early 1980's. The superconducting material used was niobium or niobium-tin. A wide variety of conductor configurations, dielectric insulation and cryogenic enclosures were investigated. Systems studies to evaluate technical and economic factors were performed. Two large outdoor test facilities were constructed which provided data of interest to potential utility company users. Virtually all these projects are now closed down, mainly due to technical difficulties with the particular design chosen or due to the realization that the next development phase, the transfer of the technology into industry, will be very expensive compared to the original R and D costs. At present no funding agency sets a high priority on the development of superconducting power transmission systems. DOE

**N88-19347#** Sandia National Labs., Albuquerque, N. Mex.
**RADIATION RESPONSE OF THIN OXIDES GROWN BY RAPID THERMAL OXIDATION AND RAPID THERMAL ANNEALING TECHNIQUES**
W. K. Schubert and C. H. Seager 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003632; SAND-87-1547C; CONF-871124-48) Avail: NTIS HC A02/MF A01

High quality, 20 to 30 nm thick SiO2 films were grown using rapid thermal oxidation techniques. Metal-oxide-semiconductor (MOS) capacitors formed with these oxides were characterized electrically using low and high frequency capacitance measurements. The effects of post oxidation annealing (POA) ambient, temperature and duration on the initial oxide properties and the radiation response of the MOS capacitors were determined. The addition of a small amount of O2 to the POA ambient significantly reduced the radiation induced hole trapping and

interface state creation, particularly for the higher POA temperatures. In addition, annealing and reirradiation experiments were carried out and showed that both the trapped charge and interface state buildup were completely reversible after anneals at 400 C. This repeatability argues against interface state creation models which involve irreversible changes in the atomic arrangements near the interface. DOE

**N88-19348#** California Univ., Berkeley. Lawrence Berkeley Lab.
**SPATIAL DISTRIBUTION OF CARBON AND NATIVE DEFECTS IN LARGE-DIAMETER BULK GROWN GaAs**
W. Walukiewicz, E. Bourret, W. F. Yau, R. E. McMurray, Jr., E. E. Haller, and D. Bliss Apr. 1987 9 p Presented at the International Symposium on Defect Recognition and Image Processing in 3-5 Compounds (DRIP 2), Monterey, Calif., 27 Apr. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003870; LBL-22751; CONF-8704248-2) Avail: NTIS HC A02/MF A01

Different spectroscopic techniques have been combined to measure concentrations of carbon on arsenic sites and of neutral EL2. Utilizing the recently found dependence of the high resolution local vibrational mode spectrum on the charge state of the carbon acceptors we have been able to separately determine concentrations of neutral and ionized carbon after EL2 has been optically quenched. The concentration of ionized carbon shows a very distinct W-shaped variation across the wafer whereas the total carbon concentration is close to constant. The variations are caused by the nonuniform distribution of donors which are shallower than EL2. They account for the commonly observed variations of the near infrared absorption. Radiotracer experiments with GaAs crystals intentionally doped with (14)C showed that carbon is very homogeneously distributed in GaAs grown by horizontal Bridgman method. No correlation between the distribution of carbon and dislocations has been found. DOE

**N88-19349#** California Univ., Berkeley. Lawrence Berkeley Lab.
**SCANNING TUNNELING MICROSCOPY OF SILVER, GOLD, AND ALUMINIUM MONOMERS AND SMALL CLUSTERS ON GRAPHITE**
E. Ganz, K. Sattler, and J. Clarke Jul. 1987 23 p Presented at the 2nd International Conference on Scanning Tunneling Microscopy/Spectroscopy, Oxnard, Calif., 20 Jul. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003871; LBL-23263; CONF-8707142-1) Avail: NTIS HC A03/MF A01

We have deposited small numbers of atoms of silver, gold, and aluminum onto cleaved graphite substrates in ultra high vacuum. Using a scanning tunneling microscope, we have observed monomers, groups of monomers, dimers and a trimer. The adsorption sites and atomic spacings are determined by direct observation. DOE

**N88-19350#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ELECTRONIC STRUCTURE AND PHASE STABILITY OF ALLOYS**
D. deFontaine Oct. 1987 15 p Presented at the US-Japan Seminar on Electronic Structure and Lattice Defects in Alloys, Honolulu, Hawaii, 4 May 1987
(Contract DE-AC03-76SF-00098)
(DE88-004574; LBL-24262; CONF-8705226-3) Avail: NTIS HC A03/MF A01

The computation of phase diagrams from first principles requires the combination of very precise quantum mechanical, statistical mechanical, and ground state calculations. Various methods of accomplishing this task are reviewed, such as the Gautier and Ducastelle Generalized Perturbation Method and the cluster inversion method of Connolly and Williams. As an example of the former, a calculation of the Ti-Rh phase diagram is presented. DOE

**N88-19351#** Oak Ridge National Lab., Tenn.
**AN IN SITU ANNEALING STUDY OF LEAD IMPLANTED SINGLE CRYSTAL CALCIUM TITANATE**
J. Rankin, L. W. Hobbs, L. A. Boatner, and C. W. White Jul. 1987 13 p Presented at the Radiation Effects in Insulators-4 Conference, Lyon, France, 6 Jul. 1987 Prepared in cooperation with MIT, Cambridge
(Contracts DE-AC05-84OR-21400; DE-FG02-84ER-45090)
(DE88-005435; CONF-870783-7) Avail: NTIS HC A03/MF A01

In situ annealing studies have been carried out in ion-implanted single crystals of CaTiO3. These crystals were implanted along both the a and b axes of this orthorhombic perovskite structure (Pcmn). A VCR connected to a television system on a transmission electron microscope was used to observe the regrowth process and monitor the growth rate. Samples were annealed in a single tilt hot stage at approx. 475 C. The near-surface region of this material, approximately 190 nm, is turned amorphous by the implantation of 540 KeV Pb ions at a fluence of 1(10 to the 15th power/sq cm). Annealing at 475 C results in the epitaxial regrowth of the damaged region. The regrowth process begins at the original amorphous crystalline interface and proceeds outward to the surface. This phenomenon has been studied for implantations along both the <010> and the <100> crystallographic directions. For constant accelerating voltage and fluence of the implanted lead ions, transmission electron microscopy and Rutherford backscattering spectroscopy indicate that the regrowth rate is linear with time but strongly dependent on the oxygen partial pressure in the annealing atmosphere, and the implantation and subsequent regrowth direction. strongly dependent on the oxygen partial pressure in the annealing atmosphere, and the implantation and subsequent regrowth direction. DOE

**N88-19352#** California Univ., Berkeley. Lawrence Berkeley Lab.
**ELECTRON MICROSCOPY STUDY OF MORPHOLOGY AND COMPOSITION OF A FERRISILICATE CATALYST**
R. Csencsits, R. Gronsky, V. Nair, and R. Szostak Dec. 1987 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Union Carbide Corp., Tarrytown, N.Y. and Georgia Inst. of Tech., Atlanta
(Contract DE-AC03-76SF-00098)
(DE88-005754; LBL-24117; CONF-871124-70) Avail: NTIS HC A02/MF A01

The effects of various synthesis conditions on the structure and composition of ferrisilicate analogs of zeolite ZSM-5 were considered. Scanning electron microscopy (SEM) was used to determine the particles size distributions and morphologies. Particle sizes vary from tenths of a micron to several microns, depending on degree of agitation during crystal growth, while morphology is additionally dependent on the concentration of iron in the gel during crystallization. X-ray emissive spectroscopy (XES) performed in the transmission electron microscope (TEM) was used to determine their composition variation. The distribution of iron among the crystals is more homogeneous if the gel is stirred and it does not depend on particle size. DOE

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

**N88-19353#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
**NOTES ON A CLASS OF HOMOGENEOUS SPACE-TIMES**
M. O. Calvao, M. J. Reboucas, A. F. F. Teixeira, and W. M. SilvaJunior 1987 14 p
(DE88-700138; CBPF-NF-008/87) Avail: NTIS (US Sales Only) HC A03/MF A01

The breakdown of causality in homogeneous Goedel-type space-time manifolds is examined. An extension of Reboucas-Tiomno (RT) study is made. The existence of noncausal curves is also investigated under two different conditions on the energy-momentum tensor. An integral representation of the infinitesimal generators of isometries is obtained extending previous works on the RT geometry. DOE

**N88-19354#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
**CONNECTION BETWEEN GENERAL OBSERVERS AND LANCZOS POTENTIAL**
M. Novello and A. L. Velloso 1987 28 p
(DE88-700139; CBPF-NF-012/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Some algorithms to find the explicity form of Lanczos potential in an arbitrary geometry are presented. DOE

**N88-19355#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
**EXPERIMENTAL ANALYSIS OF ABSOLUTE SPACE-TIME LORENTZ THEORIES**
A. K. A. Maciel and J. Tiomno 1987 20 p
(DE88-700140; CBPF-NF-013/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Experiments designed to test Special Relativity are reviewed and their capabilities of distinguishing Special Relativity from Absolute Space-Time theories are analyzed. Of two specific forms of Absolute theories proposed in recent years, it is shown that one is refuted by past experiments while the other is still in contention. DOE

**N88-19356#** Comision de Energia Atomica, La Habana (Cuba).
**SEVENTY YEARS OF THE GENERAL THEORY OF RELATIVITY**
F. CastroDiaz-Balart and R. CabezasSolorzano Jun. 1986 50 p In SPANISH; ENGLISH summary
(DE88-700784; CEAC-R-2-86; ININ-2) Avail: NTIS (US Sales Only) HC A03/MF A01

In view of the 70th anniversary of the discovery of the General Theory of Relativity, an analysis was made of the special and general theories. The basic postulates, their consequences in the formulation of the theories, the main results, some aspects related to the experimental verification and its applications are presented, as are some elements of the mathematical formalism of the theories, to facilitate the logical interrelationships between its results and consequences. DOE

**N88-19357** New South Wales Univ., Sydney (Australia).
**GENERALISED SCATTERING MODEL FOR THE QUANTUM MODULATION OF ELECTRONS Abstract Only. Ph.D. Thesis**
P. H. Handel Nov. 1986 88 p
Avail: Issuing Activity

The discussion of the coherence of matter waves is picked up from the beginning of the Schwarz-Hora effect including developments reviewed by Hawkes and indicating further generalizations by the Hanbury-Brown/Twiss effect. A consequent generalization of the scattering theory of the quantum modulation is presented based on a Green's function solution which results in the fact that far-field superpositions only lead to interferences. The problem of the re-emission of photons from quantum modulated electron beams is discussed and experiments on indirect observations of the phenomena in microwave amplification and in the I/f noise Handel effect are reported. In the last case the self-interaction of electrons is involved in the Handel effect. A further second-quantised derivation and the coherent state Handel effect is presented. Author

**N88-19358#** Argonne National Lab., Ill.
**WHITHER MANY-BODY THEORY. A SUMMARY OF THE OULU CONFERENCE**
J. W. Clark 1987 20 p The 5th International Conference on the Recent Progress in the Many-body Theories was held in Oulu, Finland, 3 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-003095; CONF-8708158-Summ) Avail: NTIS HC A03/MF A01

There are basically two types of contributions to many-body theory, those focusing on the development of new methods and techniques and those which seek to understand many-body phenomena in particular systems. The work presented at this conference is weighted far more heavily toward applications and toward the explication of mechanisms underlying observed phenomena than was the case at previous conferences. In the topical composition of this conference we observe also a shift away from the hard-core systems (the helium liquids and solids, nuclei, nuclear matter) which have dominated the attention of microscopic theorists for three decades. The new emphasis is on not-so-strongly-interacting systems, primarily electronic systems in various guises of current experimental relevance. In particular, the impact of the new discoveries of high-temperature superconductors on the thrust of many-body theories is already apparent in many of the papers at this conference. DOE

**N88-19359#** Florida Univ., Gainesville. Dept. of Physics.
**THE EARLY YEARS OF STRING THEORY: THE DUAL RESONANCE MODEL**
P. Ramond Oct. 1987 60 p Presented at the Theoretical Advanced Summer Institute, Santa Fe, N. Mex., 6 Jul. 1987
(Contract DE-FG05-86ER-40272)
(DE88-003521; DOE/ER-40272/47; CONF-8707141-2; UFTP-87-19) Avail: NTIS HC A04/MF A01

This paper reviews the past quantum mechanical history of the dual resonance model which is an early string theory. The content of this paper is listed as follows: historical review, the Veneziano amplitude, the operator formalism, the ghost story, and the string story. DOE

**N88-19360#** Sandia National Labs., Albuquerque, N. Mex.
**THERMODYNAMICS OF WETTING BY LIQUID METALS**
F. G. Yost and A. D. Romig, Jr. 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003634; SAND-87-1502C; CONF-871124-38) Avail: NTIS HC A02/MF A01

The wetting of metal surfaces by molten solder is usually considered to be driven solely by an interfacial energy imbalance. The effect of chemical reactions on the wetting process is neglected, although the growth of an intermetallic layer in the wetted interface is commonly observed. In this work, the energy release during the incremental advance of a spreading solder droplet due to the interfacial energy imbalance and the formation of the intermetallic layer is calculated. The free energy of formation, (DELTA)G, of the intermetallic layer is shown to be an important driving force for solder wetting. This approach to setting has been applied to three systems, Cu-Sn, Cu-Sb and Cu-Cd. Liquid Sn, Sb and Cd react with solid Cu to form Cu6Sn5(eta), Cu2Sb(GAMMA) and CuCd3(epsilon), respectively. DOE

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N88-19361#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**META-ANALYSIS OF LEADERSHIP DIFFERENCES BETWEEN MALES AND FEMALES AND THE EFFECT ON PERFORMANCE M.S. Thesis**
Jane A. Farrell Sep. 1987 65 p
(AD-A187769; AFIT/GLM/LSR/87S-24) Avail: NTIS HC A04/MF A01 CSCL 05I

The purpose of this study was to summarize the effects of women leaders on organizational performance. This thesis examined those studies which have dealt with leadership differences in male and female manager/leaders and the effects of these differences on performance. The statistics reported in each study were systematically converted to a common measure known as effect size. The results of all studies were then combined in a procedure known as meta-analysis. Meta-analysis is systematic and replicable and therefore can lead to conclusions that are more generalizable than traditional review methods. The issue of women leader's effects on performance is important because the number of women in the United States military has grown in the past four decades from two percent to over eleven percent. Over the next five years the Air Force is expected to increase its percentage of women to 20 percent of the total force. The results indicated no significant difference in performance of an organization whether led by a male or a female. Any differences that did occur could be attributed to other factors besides sex of the leader. GRA

**N88-19362#** Council of Scientific and Industrial Research, New Delhi (India).
**SCIENCE AND TECHNOLOGY IN INDIA Status Report, 1986**
Nov. 1986 90 p
(PB88-134747) Avail: NTIS HC A05/MF A01 CSCL 05A

The Government of India is the chief patron of science and technology in the country. The central governmental structure for scientific research and development is given in a separate section. Important policy measures taken since the previous status report was prepared (1982), an overview of S and T in the Sixth Five-Year Plan (1980 to 1985), and the main thrust of the current (seventh) Five-Year Plan (1985 to 1990) and its S and T components are given in sections that follow, which also deal with the functions of the various department/agencies under the Central Government and some recent highlights of their work, agency-wise. The rest of the sections deal with some salient aspects of the S and T scene in the country, with some statistics wherever available. Also included is a short list of institutions engaged in S and T research and related activities. GRA

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

**N88-19363#** Systems Consultants, Inc., San Diego, Calif.
**AITI TEST REPORT 87-002: PRATT AND WHITNEY TECHNICAL ORDER TRANSFER TESTS**
12 Jun. 1987 40 p
(Contract W-7405-eng-48)
(DE88-004045; UCRL-15935) Avail: NTIS HC A03

The AFLC/AITI Standards Project is testing the Military Standard for the Automated Interchange of Technical Information, MIL STD-1840 (the Standard). The objective of the test is to demonstrate the validity of the transfer protocol defined in the Standard itself and the viability of standardized formats for the transfer of technical information defined in other specifications used by the Standard. DOE

**N88-19364#** Systems Consultants, Inc., San Diego, Calif.
**AITI REPORT 87-003: HONEYWELL TECHNICAL ORDER TRANSFER TESTS**
Jul. 1987 40 p
(Contract W-7405-eng-48)
(DE88-004046; UCRL-15952) Avail: NTIS HC A03

The AFLC/AITI Standards Project is testing the Military Standard for the Automated Interchange of Technical Information (the Standard). The objective of the test is to demonstrate the validity of the transfer protocol defined in the Standard itself and the viability of standardized formats for the transfer of technical information defined in other specifications used by the Standard. DOE

**N88-19365#** California Univ., Berkeley. Electronics Research Lab.
**THE DESIGN OF THE POSTGRES STORAGE SYSTEM**
Michael Stonebraker 4 Feb. 1987 14 p
(Contract N00039-84-C-0089; ARPA Order 4871)
(AD-A187244; UCB/ERL-M87/6) Avail: NTIS HC A03/MF A01 CSCL 12F

This paper presents the design of the storage system for the POSTGRES data base system under construction at Berkeley. It is novel in several ways. First, the storage manager supports transaction management but does so without using a conventional write ahead log (WAL). In fact, there is no code to run at recovery time, and consequently recovery from crashes is essentially instantaneous. Second, the storage manager allows a user to optionally keep the entire past history of data base objects by closely integrating an archival storage system to which historical records are spooled. Lastly, the storage manager is consciously constructed as a collection of asynchronous processes. Hence, a large monolithic body of code is avoided and opportunities for parallelism can be exploited. The paper concludes with a analysis of the storage system which suggests that it is performance competitive with WAL systems in many situations. GRA

**N88-19366#** Advanced Engineering Lab., Adelaide (Australia).
**DATA ACQUISITION AND PROCESSING FOR SURFACE PLATE CALIBRATION**
R. W. Levinge Mar. 1987 37 p
(AD-A187264; AEL-0286-TM; DODA-AR-004-924) Avail: NTIS HC A03/MF A01 CSCL 12E

A method for acquiring and processing data for surface plate calibration is described. It controls acquisition procedure, minimizes the work of analysis and presents the results as departures from a mean plane at a number of fixed points on the surface. Automatic entry and storage avoids copying errors when reading data. GRA

**N88-19367#** Ontologic, Inc., Billerica, Mass.
**UNIVERS PRODUCT, PHASE 1 Final Report**
Michael J. Vilot and Robert M. Strong 27 Apr. 1987 112 p
(Contract N00014-86-C-0605)
(AD-A187405) Avail: NTIS HC A06/MF A01 CSCL 12G

This project investigated extensible databases for design applications. These applications have complex data modeling needs not adequately met by existing database systems. Our goal is to combine the abstraction and modularity of modern programming languages and the persistent storage management of databases with the inheritance/refinement mechanism of object-oriented systems to provide an extensible database product. The first phase objectives are to investigate data modeling and representation requirements for extensibility. Our primary focus is on programming language access to the extensibility mechanisms of an object-oriented database. Phase I produced a definition of requirements for the product we call UNIVERS -- the UNIfication of programming language and database technology, with the VERSatility of object-oriented systems. It also establishes a

high-level (architectural) design for UNIVERS, including a description of the programming language/database interface. The resulting product is an Ada language interface providing access to the contractor's existing database product, Vbase. Vbase is an object-oriented database development platform targeted at the needs of the engineering design application builder, designed to serve as a foundation for MCAD, ECAD, and CIM applications. GRA

**N88-19368#** North Carolina Univ., Chapel Hill. Dept. of Computer Science.
**SUPPORTING VALID TIME: AN HISTORICAL ALGEBRA**
Edwin McKenzie and Richard Snodgrass Aug. 1987 53 p
(Contract N00014-86-K-0680)
(AD-A187740; TR87-008) Avail: NTIS HC A04/MF A01
CSCL 12A

The authors define an historical algebra for historical relations. This historical algebra, a straightforward extension of the conventional relational algebra, supports valid time, the time when an object or relationship in the enterprise being modeled is valid. Historical versions of the five relational operators union, difference, cartesian product, selection, and projection are defined and a new operator, historical derivation, is introduced. The algebra includes aggregates and is shown to have the expressive power of the temporal query language TQuel. The algebra is consistent with the user-oriented model of historical relations as space-filling objects and satisfies all but one of the associative, commutative, and distributive tautologies involving union, difference, and cartesian product. GRA

**N88-19369#** Naval Postgraduate School, Monterey, Calif.
**ACCESSING HIERARCHICAL DATABASES VIA SQL TRANSACTIONS IN A MULTI-MODEL DATABASE SYSTEM M.S. Thesis**
John A. Zawis Dec. 1987 124 p
(AD-A187878) Avail: NTIS HC A06/MF A01 CSCL 12G

There has been a tremendous growth in recent years in the use of data base management systems (DBMS) throughout the world. The multi-lingual database system (MLDS) was designed to increase the functionality of data base systems by allowing the use of multiple data models and several model based languages on a single system. This system could support a heterogeneous collection of databases, each based on the data model most appropriate for the individual application requirements. MLDS currently supports the use of relational, hierarchical, network, and functional databases. The goal of this thesis is to further increase the functionality of MLDS by permitting a user knowledgeable only in a relational-based data language (SQL) to access and manipulate information in a hierarchical database, while strictly maintaining the integrity of the hierarchical model. This extends the multi-lingual database system to a multi-model database system (MMDS). The emphasis in this thesis is two fold. First, to provide the design analysis necessary to accomplish the translation. More specifically, to develop a process for transforming a hierarchical database schema into an equivalent relational schema and to analyze the SQL requests that are used to access a database and provide a methodology for equivalent access to a hierarchy -based database system. The second area of emphasis is in the implementation of the schema transformation process and language translation methodology within the current MLDS structure. The software engineering aspects of the implementation are detailed to provide a base for further expansion of similar systems. GRA

**N88-19370#** RAND Corp., Santa Monica, Calif.
**SOVIET HIGH-TECHNOLOGY RESTRUCTURING DRIVE: THE MNTK NETWORK Interim Report**
Simon Kassel Aug. 1987 57 p
(AD-A188138; RAND/N-2612-DARPA) Avail: NTIS HC
A04/MF A01 CSCL 05D

The recent establishment of a network of interbranch science and technology complexes, known as MNTKs in Soviet parlance, represents the latest and strongest attempt to overcome the chronic Soviet lag in advanced technologies. The new organizations have been created within the framework of the current drive to restructure the Soviet economy, as a means of integrating science and industry. The MNTKs are impressive in the speed of their introduction, their size, and the uprecedented nature of their charter. The promise of the MNTK network as the principal instrument for solving the problem of advanced technologies is threatened by the considerable cleavage between the government's plans and decrees, and their realization in practice. In contrast to the speed of their formal establishment, further steps toward practical implementation of the MNTKs have been quite slow. Bureaucratic resistance has been eroding the effectiveness of the new organizations, particularly the power to enforce their new rights and privileges. As a result, Soviet observers question the potential of the MNTKs, and some critics already call them paper tigers. In balance is Soviet capability for technological and military competition with the West. GRA

**N88-19371#** Naval Research Lab., Washington, D.C.
**ALLOCATION OF DATABASE FILES ACROSS PARALLEL STORES FOR EFFICIENT PROCESSING OF PARTIAL-MATCH QUERIES Formal Report, Jan. - May 1987**
Thor Bestul and Sushil Jajodia 27 Oct. 1987 12 p
(AD-A188196; NRL-9084) Avail: NTIS HC A03/MF A01
CSCL 12E

This report presents the results of research on the allocation of binary cartesian product database files across several stores (such as disks) which are accessible in parallel so that the average time required to perform the retrieval (by using several parallel accesses) of all buckets specified by a partial-match query is objective of constructing efficient packings of Hamming spheres in hypercubes. The viewpoint of binary cartesian product file allocation thus produced allowed in our research the creation of allocations for two particular sizes of the set of stores such that the average processing time for partial-match queries was smaller than that of the best allocation technique found in the literature for these same two cases. It also provides a framework in which good allocations for other particular sizes of the set of stores, and possibly for general sets of stores, might be found. GRA

**N88-19372#** Army Engineer Topographic Labs., Fort Belvoir, Va.
**THE US ARMY ELECTRONIC MAP DATA (EMD) INITIATIVE**
Douglas R. Caldwell 13 Jul. 1987 9 p
(AD-A188209; ETL-R117) Avail: NTIS HC A02/MF A01
CSCL 08B

Electronic Map Data (EMD) is a generic term describing raster format databases created by scanning hardcopy maps or charts. EMD offers great potential as an interim solution for users requiring a digital picture of the current paper products. It is more flexible than video disc image databases and can be generated quickly in significantly greater quantities than attributed vector databases. The U.S. Army will be a major consumer of EMD products as a source of geographic data prior to the production of Tactical Terrain Data (TTD) in the mid-1990's. This paper describes the origins of the Army's EMD product requirements as well as the current initiative to define and articulate that requirement to the Defense Mapping Agency (DMA). GRA

**N88-19373#** Government of India, New Delhi.
**DISTRICT INFORMATION SYSTEM OF NATIONAL INFORMATION CENTRE**
1987 21 p
(PB88-134739) Avail: NTIS HC A03/MF A01 CSCL 05B

National Informatics Centre (NIC), a project of the Government of India under the Department of Electronics, was given the responsibility of creating appropriate information systems to facilitate the planning and decision making process in the Ministries/Departments of Government of India and State Governments in the country. To this end, NIC established an intra-city computer network in Delhi called NICNET, consisting of 15 computer systems and 35 interactive terminals located in various Bhavans of Delhi and connected to a large computer system CYBER 170/730. In its second phase, NIC is extending NICNET

to cover the entire country. The PC/AT-compatible systems installed in the district headquarters will form the third level of NICNET. Selected information from the districts will be transmitted to the state computers which will sift through similar information from all districts before passing it on to the regional and national centers. GRA

**N88-18954*#** Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
**ROCKETDYNE AUTOMATED DYNAMICS DATA ANALYSIS AND MANAGEMENT SYSTEM**
Robert B. Tarn *In* NASA. Marshall Space Flight Center, The 58th Shock and Vibration Symposium, Volume 2 Feb. 1988 p 151-164 (For primary document see N88-18948 11-39)
(Contract NAS8-27980)
Avail: NTIS HC A10/MF A01 CSCL 05B

# 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**N88-19374#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
**ROBUSTNESS IN COST PERFORMANCE MODELS M.S. Thesis**
Darren E. Morgan Sep. 1987 85 p
(AD-A187183; AFIT/GSM/LSY/87S-23) Avail: NTIS HC A05/MF A01 CSCL 05C

This thesis examined the robustness of methods used to compute estimates at completion of contract costs. The four techniques examined were a subset of those used by the Cost Performance Report Analysis computer program to derive estimates at completion. Monte Carlo simulation methods were used to generate the required data values for 18 simulated populations representing a variety of possible cost and schedule overrun scenarios. A statistical evaluation of the robustness of the four estimates at completion techniques was performed using samples from each of the 18 simulated populations. The results of this analysis indicate that, for practical purposes, none of the selected estimate at completion techniques are robust for the cost and schedule overrun scenarios that were investigated. The tendency of each of the estimate at completion models was to underestimate the final contract cost. The estimate at completion models incorporating mathematical smoothing techniques (i.e., weightings or moving averages) provided relatively stable results across all of the populations; however, they were unable to consistently predict a contract's completion cost within 30 percent of the actual value. GRA

# 84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**N88-19375*#** National Aeronautics and Space Administration, Washington, D.C.
**SPACELAB: AN INTERNATIONAL SUCCESS STORY**
Douglas R. Lord (Science Applications International Corp., Washington, D.C.) 1987 565 p Original contains color illustrations
(Contract NASw-4092)
(NASA-SP-487; NAS 1.21:487; LC-86-17979) Avail: NTIS HC A24/MF A01 CSCL 05D

Spacelab is a European-developed and U.S.-operated space laboratory carried in the cargo bay of the Space Shuttle Orbiter. This story of the Spacelab Development Program traces the program from the origin of the Spacelab concept, describing negotiations and agreements for European participation and the role of Europe and the United States in system development, operational capability development, and utilization planning. It also considers the joint management structure, coordination, and experience in solving management and technical interface problems. The book is not an exhaustive historical treatise, but an informative and readable story of the evolution and technical accomplishments of this unique program in manned space flight and of some of the unusual political and human interest aspects of the program from the viewpoint of one of the key participants. Author

# 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

**N88-19376#** City of Cypress, Calif.
**ELECTRIC VEHICLE DEMONSTRATION PROJECT Draft Final Closeout Report**
Dec. 1987 9 p
(Contract DE-FC08-80NV-10112)
(DE88-004076; DOE/NV-10112/T1) Avail: NTIS HC A02/MF A01

On February 27, 1980, the city of Cypress was awarded a federal grant to participate in the Department of Energy's Electrical Vehicle Demonstration Program. The initial Cooperative Agreement (CA) between the city and the Department of Energy (DOE), was executed May 13, 1980, for a four (4) year period. The first year of the Agreement was dedicated to acquiring the vehicles, training the operators and designing the data collection system. Both parties entered into several annual CA modifications which extended the program through December 31, 1986. The city began receiving shipment of the vehicles in November 1980, with all vehicles recieved by April 1981. The electric vehicles were assigned to a wide variety of city service areas including: maintenance, police parking enforcement, engineering, planning, recreation and parks and central services. DOE

**N88-19377*#** Priem Consultants, Inc., Cleveland, Ohio.
**STUDY OF INDUSTRY REQUIREMENTS THAT CAN BE FULFILLED BY COMBUSTION EXPERIMENTATION ABOARD SPACE STATION Final Contractor Report**
Richard J. Priem Mar. 1988 62 p
(Contract NAS3-24105)
(NASA-CR-180854; E-3901; NAS 1.26:180854) Avail: NTIS HC A04/MF A01 CSCL 22A

The purpose of this study is to define the requirements of commercially motivated microgravity combustion experiments and the optimal way for space station to accommodate these requirements. Representatives of commercial organizations, universities and government agencies were contacted. Interest in and needs for microgravity combustion studies are identified for commercial/industrial groups involved in fire safety with terrestrial applications, fire safety with space applications, propulsion and power, industrial burners, or pollution control. From these interests and needs experiments involving: (1) no flow with solid or liquid fuels; (2) homogeneous mixtures of fuel and air; (3) low flow with solid or liquid fuels; (4) low flow with gaseous fuel; (5) high pressure combustion; and (6) special burner systems are described and space station resource requirements for each type of experiment provided. Critical technologies involving the creation of a laboratory environment and methods for combining experimental needs into one experiment in order to obtain effective use of space station are discussed. Diagnostic techniques for monitoring combustion process parameters are identified. Author

**N88-19378#** Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
**AFAL (AIR FORCE ASTRONAUTICS LABORATORY) TECHNICAL OBJECTIVE DOCUMENT FY89**
Dec. 1987 113 p
(AD-A187861; AFAL-TR-87-058) Avail: NTIS HC A06/MF A01 CSCL 21H

A summary is presented of technical objectives and approaches for research, exploratory development, and advanced development efforts being pursued, and to be pursued for FY88 to 92. AFAL's program is organized into five technical thrusts: one for each of the three major rocket propulsion applications areas i.e., ballistic missiles, air-launched missiles and space propulsion systems; one for propulsion technology; and one for non-propulsive space systems. Author

**N88-19379*#** Auburn Univ., Ala. Dept. of Aerospace Engineering.
**A LUNAR TRANSPORTATION SYSTEM**
Jun. 1986 94 p
(Grant NGT-21-002-080)
(NASA-CR-182561; NAS 1.26:182561) Avail: NTIS HC A05/MF A01 CSCL 13F

Due to large amounts of oxygen required for space travel, a method of mining, transporting, and storing this oxygen in space would facilitate further space exploration. The following project deals specifically with the methods for transporting liquid oxygen from the lunar surface to the Lunar Orbit (LO) space station, and then to the Lower Earth Orbit (LEO) space station. Two vehicles were designed for operation between the LEO and LO space stations. The first of these vehicles is an aerobraked design vehicle. The Aerobrake Orbital Transfer Vehicle (OTV) is capable of transporting 5000 lbm of payload to LO while returning to LEO with 60,000 lbm of liquid oxygen, and thus meet mission requirements. The second vehicle can deliver 18,000 lbm of payload to LO and is capable of bringing 60,000 lbm of liquid oxygen back to LEO. A lunar landing vehicle was also designed for operation between LO and the established moon base. The use of an electromagnetic railgun as a method for launching the lunar lander was also investigated. The feasibility of the railgun is doubtful at this time. A system of spheres was also designed for proper storing and transporting of the liquid oxygen. The system assumes a safe means for transferring the liquid oxygen from tank to tank is operational. A sophisticated life support system was developed for both the OTV and the lunar lander. This system focuses on such factors as the vehicle environment, waste management, water requirements, food requirements, and oxygen requirements. Author

**N88-19380*#** Utah State Univ., Logan.
**MARS LANDER/ROVER VEHICLE DEVELOPMENT: AN ADVANCED SPACE DESIGN PROJECT FOR USRA AND NASA/OAST Interim Report**
1986 34 p
(Grant NGT-80001)
(NASA-CR-182570; NAS 1.26:182570) Avail: NTIS HC A03/MF A01 CSCL 13F

A design is proposed for a Mars Lander/Rover (MLR) for use in gathering needed environmental and surface information. The design focus will be upon a Mars Lander/Rover that will leave an orbit around Mars, reenter and soft land on the Martian surface, and move sequentially to widely scattered locations to sample, measure, and analyze the Martian environmental and surface conditions. Primary goals will be payload mass and size definition, characterization of the Martian atmosphere, selection of sampling locations, identification of alternative design concepts, selection of a preferred design, team organization, and preparation for the detailed design phase. B.G.

**N88-19381#** National Bureau of Standards, Gaithersburg, Md.
**STATUS OF EMERGING TECHNOLOGIES: AN ECONOMIC/TECHNOLOGICAL ASSESSMENT TO THE YEAR 2000 Final Report**
E. Ambler Jun. 1987 33 p
(PB88-155775; NBSIR-87/3671) Avail: NTIS HC A03/MF A01 CSCL 05A

The Department of Commerce has concluded, in a review of emerging technologies and their future impacts on the economy, that American businesses lag behind many of their foreign competitors especially the Japanese, in exploiting technological breakthroughs. The review was ordered by Deputy Secretary Clarence J. Brown in April 1986 to identify the new technologies that will lead to new products or processes, analyze their commercialization, and recommend means of reducing the barriers. It is based on assessment by technical experts and agency heads within the Department. They studied scientific and industrial plans and the commercialization process here and abroad. Remarks by Deputy Secretary Brown in releasing the report are included. Author

**N88-19382#** Lawrence Livermore National Lab., Calif.
**A STUDY OF TECHNOLOGY TRANSFER ARRANGEMENTS FOR NATIONAL LABORATORIES**
R. C. Dorf and K. K. F. Worthington 25 Aug. 1987 103 p
(Contract W-7405-eng-48)
(DE88-005423; UCRL-15967) Avail: NTIS HC A06

The transfer of technology to industrial partners and users is a complex task. The interactions between federal laboratories and industry and the market knowledge and ability to assess the needs of business users are beyond the charter of a federal laboratory. Therefore, new organizational mechanisms are required in order to obtain full commercial value from the laboratories' efforts. This paper will analyze cases of new ventures emerging from technology developed within federal laboratories. Seven models will be identified for technology transfer. These are the Information Dissemination Model, the Licensing Model, the Venture Capital Model, the Large Company-Joint Venture Model, the Incubator-Science Park Model, the Ferret Model, and the Agriculture Extension Model. Out of 13 laboratories, a Lawrence Livermore National Laboratory Partnership will be identified as having the greatest potential for successful implementation. The arrangement is a proposed consortium of the Lawrence Livermore National Laboratory, the University of California, venture capitalists, industrial firms, and federal and state agencies. DOE

**N88-19383#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**CONDITIONS AND MECHANISMS OF THE PROCESS OF TECHNOLOGICAL INNOVATION IN BRAZIL: THE ROLE OF RESEARCH INSTITUTES M.S. Thesis, 9 Jul. 1986 [CONDICIONANTES E MECANISMOS DO PROCESSO DE INOVACAO TECNOLOGICA NO BRASIL: ATUACAO DE INSTITUTOS DE PESQUISA]**
Heloneida deCarvalhoKataoka May 1987 194 p In PORTUGUESE; ENGLISH summary
(INPE-4175-TDL/274) Avail: NTIS HC A09/MF A01

This paper analyzes the role of research institutes concerning the Technological Innovation Process (PIT), in view of the bounds which are imposed on them by their external environment and by their organizational characteristics. As to the external environment, the institutional apparatus which deals with science and technology in Brazil is analyzed by studying the National System of Scientific and Technological Development (SNDCT) and the scientific and technological policies which guide the actions in technological innovation. Concerning the internal environment, the organizational characteristics of CPqD, INPE, and IPT are analyzed, trying to detect the influence that they have on internal PIT. Author

## 88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

# 89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

**N88-19384** Colorado Univ., Boulder.
**SPECTRAL IMAGES AND MULTI-COMPONENT MODELS OF THE CHROMOSPHERES OF AR LACERTAE Ph.D. Thesis**
James Edward Neff 1987 172 p
Avail: Univ. Microfilms Order No. DA8723487

The spatial structure of the chromospheres of AR Lacertae was determined by applying a spectral imaging technique to high-resolution IUE spectra of the Mg II k emission line (2795.528 A). An interactive, iterative fitting procedure that can fit the sum of up to 5 Gaussian emission components was applied to the observed profile. The primary constraints on the multi-component fits are the radial velocities of both stars and the constant interstellar absorption equivalent width. Secondary constraints are the rough constancy of the fluxes and widths of the global stellar emission components. Given the size and location of the plages, the surface fluxes can be determined. Using the low-resolution IUE/SWP spectra, the fluxes of the plages are separated by using the rotational and eclipse modulation of the observed flux. These fluxes are then divided by the plage areas to derive surface fluxes, which are used to derive emission measure distributions and the temperature and density structure within each component separately. The final result is a 3-dimensional map of the physical characteristics of the outer atmospheres. Three discrete plage regions on the K star are bright enough and large enough to be revealed by the spectral imaging technique. These plages might remain coherent spatial structures for at least several years, but their fluxes vary on a timescale of hours. There is some evidence that the plages migrate in longitude in the sense of the rotation. The global emission from the K star appears to be due to a uniform spatial distribution of similar plages. Dissert. Abstr.

**N88-19385** California Univ., Riverside.
**A SEARCH FOR MEDIUM ENERGY GAMMA RAY PULSARS Ph.D. Thesis**
William Emmett Sweeney, Jr. 1987 136 p
Avail: Univ. Microfilms Order No. DA8724375

Results are presented from a search for pulsed gamma rays from four radio pulsars, chosen for their interest to gamma ray astronomers in previous studies. The data set used for the search consists of gamma ray events at energies of 1-30 MeV, detected during a 40 hour balloon flight of the UCR double Compton scatter telescope launched at the National Scientific Balloon Facility in Palestine Texas, USA on September 30, 1978. No statistically significant signals were detected from any of the pulsars. Three sigma upper limits to pulsed 1-30 MeV gamma ray flux from PSR 0950+08, PSR 1822+09, PSR 1929+10, and PSR 1953+29 are presented. Two complete exposures to PSR 0950+08 were obtained. The reported tentative detection of 1-20 MeV gamma rays from PSR 0950+08 is not confirmed. Dissert. Abstr.

# 90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

**N88-19386** North Carolina Univ., Chapel Hill.
**THE DISTANCES AND ABSOLUTE MAGNITUDES OF RR LYRAE VARIABLE STARS Ph.D. Thesis**
Rodney Vaughn Jones 1987 234 p
Avail: Univ. Microfilms Order No. DA8722308

Complete optical and infrared photometry have been acquired for three field RR Lyrae variables: the very metal-poor RRab-type variable X Arietis, the moderately metal-rich RRab star SW Draconis, and the moderately metal-rich RRc-type star DH Pegasi. Radial velocities with typical accuracies of 1 km/sec have also been obtained for these stars nearly simultaneously with the photometry. Three versions of the Baade-Wesselink method were applied, and it was determined that only combinations involving the use of the V-K color index yielded self-consistent results, due to the occurrence of a redistribution of flux during the expansion phase of the pulsation cycle such that there is an excess of flux in the blue optical region. The study of the three program stars shows that there is no dependence of the value of (M sub V) of RR Lyrae stars on their metallicity, although this is not definitive due to their unclear evolutionary status. If these stars are indeed typical of RR Lyrae variables, then the results of (M sub V) = +0.80 + or - 0.14 mag and (M sub bol) = +0.85 + or - 0.15 mag for the program stars indicate that stars of this class may be less luminous than previously thought. The results imply that metal-poor globular clusters are older than metal-rich clusters, and that the oldest globular clusters may have an age of about 23 billion years. Dissert. Abstr.

**N88-19387#** Sao Paulo Univ. (Brazil). Inst. de Fisica.
**CAN THE CAUSAL PATHOLOGIES OF GOEDEL-TYPE UNIVERSES BE AVOIDED IN HIGHER-DERIVATIVE GRAVITY**
A. J. Accioly and A. T. Goncalves Oct. 1986 10 p
(DE88-700185; IFUSP-P-605) Avail: NTIS (US Sales Only) HC A02/MF A01

A completely causal rotating Goedal-type universe is obtained in the context of higher-derivative gravity. The solution is such that it has no similarity in the framework of standard general relativity. The aforementioned solution presents the interesting feature of relating the mass of the nontachyonic spin-O particle, concerning the linearized higher-derivative theory, with the velocity of rigid rotation of matter. DOE

**N88-19388#** Goettingen Univ. (West Germany). Mathematisch-Naturwissenschaftlichen Fachbereiche.
**INTERMIXING PROCESSES IN MASSIVE STARS AND THEIR INFLUENCE ON STELLAR EVOLUTION AND NUCLEOSYNTHESIS Ph.D. Thesis [DURCHMISCHUNGSPROZESSE IN MASSEREICHEN STERNEN UND IHR EINFLUSS AUF STELLARE ENTWICKLUNG UND NUKLEOSYNTHESE]**
Norbert Langer 1986 189 p In GERMAN
(ETN-88-91484) Avail: NTIS HC A09/MF A01

The influence of several mixing processes due to convective overshooting and semiconvection in the interior of massive single stars on their evolution as well as on the nucleosynthesis products was investigated, mainly during the phase of central helium burning. All the calculations were performed using a stellar evolution program that also determines the dependence of nucleosynthesis on the mixing processes. The theoretical uncertainties were limited using results of observations. Core growth due to overshooting was determined. Semiconvection and overshooting substantially affect the evolution of mass-losing, helium-burning stars, as well as the stellar nucleosynthesis. The hydrostatic s-process nucleosynthesis was consistently calculated in realistic stellar models. Overshooting in very massive stars is found to be an inefficient process. ESA

**N88-19389#** Tuebingen Univ. (West Germany). Fakultaet fuer Physik.
**A GLOBAL MODEL FOR PLANETARY NEBULAE, TAKING INTO ACCOUNT CENTRAL STELLAR EVOLUTION AND INFLUENCE ON HALO IONIZATION Ph.D. Thesis [EIN GESAMTMODELL FUER PLANETARISCHE NEBEL UNTER BESONDERER BERUECKSICHTIGUNG DER ZENTRALSTERNENTWICKLUNG UND DEREN EINFLUSS AUF DIE HALOIONISATION]**
Martin Baessgen 1986 84 p In GERMAN
(ETN-88-91491) Avail: NTIS HC A05/MF A01

Nebula formation models were verified, emphasizing the halo around nebulae. The evolution of the central star is described. Two nebulae formation processes (two-wind model, model with fast nebula expulsion) are presented. The calculations required for the physical processes, as well as the model calculations are explained. The application domain of the two-wind model is rather limited, while the fast-expulsion model shows rough agreement with observed nebula and halo quantities. The latter model is

considered as better, although single parameter changes strongly alter the calculations. ESA

**N88-19390** Colorado Univ., Boulder.
**PHOTOHYDRODYNAMICAL PROCESSES NEAR COMPACT OBJECTS Ph.D. Thesis**
Peter Adam Becker 1987 215 p
Avail: Univ. Microfilms Order No. DA8723442

Three specific and astrophysically important types of radiation-dominated dynamical systems are studied: supercritical winds around compact objects; transrelativistic flows; and radiation-dominated shocks. The supercritical winds can be divided into discrete regions depending on the relative importance of Compton scattering, diffusion, and adiabatic cooling. The physics of relativistically hot flows around black holes and neutron stars was investigated. Hydrodynamic equations governing the behavior of a radiation-dominated ideal fluid are derived for trapped winds in the Schwarzschild metric and for optically thin winds in Newtonian gravity. The analysis of radiation-dominated shock reveals a broad range of thermal and spectral behaviors which differ qualitatively from those previously reported for low temperature and isothermal shocks. It was found that the power law spectral solutions identified in the context of cold shocks do not extend to hot or even moderately warm shocks, and that in all but the weakest shocks, sizeable temperature gradients make it difficult to justify the isothermal approximation. Dissert. Abstr.

**N88-19391** Maryland Univ., College Park.
**SPECTROSCOPIC DETERMINATIONS OF SURFACE GRAVITIES OF GIANT STARS, AND ULTRAVIOLET OBSERVATIONS OF RR LYRAE AND X ARIETIS Ph.D. Thesis**
Jeremiah Tighe Bonnell 1987 240 p
Avail: Univ. Microfilms Order No. DA8725472

The surface gravities of four giant K stars, including the well known standard stars Arcturus (alpha Boo) and Aldebaran (alpha Tau) are determined from an analysis of the molecular dissociation equilibrium of OH. High resolution FTS spectra of the infrared ground state vibration-rotation lines of the OH delta v = 1 and delta v = 2 sequences were used in the analysis. The oxygen abundances were derived from the (OI) line at 6300 and 6363 A. Lifetimes for the OH delta v = 2 sequence lines are derived based on the electric dipole moment function and rotationless Einstein A values. Masses for the stars based on the derived gravities, measured parallaxes, and angular diameters are discussed. The surface gravities of 5 more G and K giants were determined from an analysis of the molecular equilibrium of MgH, the magnesium abundances being derived from visible and near infrared high excitation potential MgI lines. The MgH/MgI gravities are compared to surface gravities derived based on an analysis of the ionization equilibrium of iron. It is found that the implied giant star masses are not significantly subsolar. Ultraviolet observations of RR Lyrae and X Arietis obtained with the Astronomical Netherlands Satellite (ANS) and the International Ultraviolet Explorer (IUE) satellite are also discussed. These observations are compared with light curves derived using model atmospheres and synthetic spectrum calculations in conjunction with angular diameters determined from photometry at longer wavelengths. A good agreement was found. Dissert. Abstr.

**N88-19392** Maryland Univ., College Park.
**MOLECULAR CLOUDS AT HIGH GALACTIC LATITUDES Ph.D. Thesis**
Loris Alberto Magnani 1987 317 p
Avail: Univ. Microfilms Order No. DA8725529

The basic properties of a new class of interstellar object, the high-latitude molecular cloud, are described. The clouds are shown to be distributed asymmetrically with respect to b = 0 deg; the distribution is consistent with a displacement of the sun of 30 pc above the midplane of the galaxy. Star counts and a statistical analysis of the velocity dispersion of the ensemble of clouds locate the clouds within a few hundred parsecs of the sun. At a mean distance of 100 pc, typical diameters and masses for the clouds are 2 pc and 40 solar masses. The results of an unbiased survey of CO emission at absolute value of b greater than or equal to 25 deg reveal that the number of individual clouds within 100 pc of the sun is approximately 120; the surface filling fraction is 4.5/100. The high-latitude molecular clouds show characteristics of both dark molecular clouds and diffuse molecular clouds. The high-latitude molecular clouds show a complicated spatial and velocity structure with examples of resolved and unresolved structure to the limit of the resolution. The age of these objects based on the kinematic crossing time of the clumps is less than or equal to 1,000,000 years, implying that these objects are the youngest known molecular clouds in the galaxy. Dissert. Abstr.

**N88-19393** Wisconsin Univ., Madison.
**THE EFFECTS OF ROTATION ON THE WINDS FROM HOT STARS Ph.D. Thesis**
Clint Horton Poe 1987 172 p
Avail: Univ. Microfilms Order No. DA8719122

A study applied a rotating, magnetic, radiation-driven wind model to Be and Wolf-Rayet stars. The mass-loss rates in the equatorial region will increase with rotation rate and an open magnetic field. The terminal velocity will increase at low rotation rates but will decrease at high rotation rates. This model makes a smooth transition from a radiation-driven wind to a rotationally and magnetically driven wind of the fast magnetic rotator type. At very high rotation rates and weak magnetic field strengths, a large mass-loss rate determined by centrifugal force near the star cannot be driven to infinity by radiation forces alone. The Be star model can produce the observationally inferred asymmetry between the polar and equatorial regions. Rotation and magnetic field produce a slower, denser equatorial wind. However, the density enhancement is not as large as required by the IRAS models of Be stars. The fast wind of the Wolf-Rayet star implied by the P-Cygni profiles arises from the radiation-driven polar regions, while the radio free-free emission is created by the dense, rotationally enhanced equatorial region. The wind is never dense and fast in the same region, thus solving the momentum problem. Wolf-Rayet stars would have to be rotating at 90 percent of their critical velocity. A second study developed a two-dimensional rotating hot star wind model in the meridional plane. For a rotating O star, this model shows that the gas pressure of a cool wind cannot support itself against the centrifugal force and there is a flow toward the equator. Dissert. Abstr.

**N88-19394** Maryland Univ., College Park.
**MASS LOSS FROM EVOLVED STARS Ph.D. Thesis**
Robert Joseph Sopka [1987] 136 p
Avail: Univ. Microfilms Order No. DA8725576

Observations are presented of CO, (C-13)O, HCN, (H-13)CN, HC3N and HNC emission lines from a number of well known evolved stars. Estimates of mass loss rates, envelope sizes, molecular abundances, and isotope ratios are derived in an attempt to understand the composition, kinematics, and chemistry of the molecular component of the mass flow. The solid component of the mass flow is investigated by means of broad band submillimeter observations of the thermal emission from dust in the circumstellar envelope. The mass loss rates in dust are compared with the mass loss rates in gas to estimate the gas-to-dust ratio in the outflowing matter and these values are found to be in general agreement with the interstellar ratio of approximately 100. The analysis of the thermal emission of the circumstellar dust which includes the 400 micron data, provides reasonably strong evidence that the grains in both carbon-rich and oxygen-rich envelopes are not crystalline but are composed of amorphous structures.
Dissert. Abstr.

**N88-19395*#** California Univ., San Diego. Center for Astrophysics and Space Science.
**TOWARD A COMPREHENSIVE THEORY FOR THE SWEEPING OF TRAPPED RADIATION BY INERT ORBITING MATTER**
Walker Fillius [1988] 35 p
(Grant NAG2-153)
(NASA-CR-182584; NAS 1.26:182584) Avail: NTIS HC A03/MF A01 CSCL 03B

There is a need to calculate loss rates when trapped Van Allen radiation encounters inert orbiting material such as planetary rings and satellites. An analytic expression for the probability of a hit in a bounce encounter is available for all cases where the absorber is spherical and the particles are gyrotropically distributed on a cylindrical flux tube. The hit probability is a function of the particle's pitch angle, the size of the absorber, and the distance between flux tube and absorber, when distances are scaled to the gyroradius of a particle moving perpendicular to the magnetic field. Using this expression, hit probabilities have been computed in drift encounters for all regimes of particle energies and absorber sizes. This technique generalizes the approach to sweeping lifetimes, and is particularly suitable for attacking the inverse problem, where one is given a sweeping signature and wants to deduce the properties of the absorber(s). Author

**N88-19396#** Fermi National Accelerator Lab., Batavia, Ill.
**BIG BANG NUCLEOSYNTHESIS: ACCELERATOR TESTS AND CAN (UC OMEGA)(SUB B) REALLY BE LARGE**
David N. Schramm Oct. 1987 10 p Presented at the Symposium on the Origin and Distribution of Elements, New Orleans, La., 31 Aug. 1987 Prepared in cooperation with Chicago Univ., Ill.
(Contract DE-AC02-76CH-03000)
(DE88-003405; FNAL/C-87/166-A; CONF-8708165-6) Avail: NTIS HC A02/MF A01

The first collider tests of cosmological theory are now underway. The number of neutrino families in nature, N(sub nu), plays a key role in elementary particle physics as well as in the synthesis of the light elements during the early evolution of the Universe. Standard Big Bang Nucleosynthesis argues for N(sub nu) = 3 plus or minus 1. Current limits on N(sub nu) from the CERN anti pp collider and e(+)e(-) colliders are presented and compared to the cosmological bound. Supernova SN 1987A is also shown to give a limit on N(sub nu) comparable to current accelerator bounds. All numbers are found to be small thus verifying the Big Bang model at an earlier epoch than is possible by traditional astronomical observations. Future measurements at SLC and LEP will further tighten this argument. Another key prediction of the standard Big Bang Nucleosynthesis is that the baryon density must be small ((UC OMEGA)(sub B) less than or equal to 0.1). Recent attempts to try to subvert this argument using homogeneities of various types are shown to run afoul of the (7)Li abundance which has now become a rather firm constraint. DOE

**N88-19397#** Lawrence Livermore National Lab., Calif.
**EFFECTS OF GALACTIC CHEMICAL EVOLUTION ON THORIUM/NEODYMIUM COSMOCHRONOLOGY**
G. J. Mathews and D. N. Schramm Nov. 1987 17 p Presented at the Symposium on the Origin and Distribution of Elements, New Orleans, La., 31 Aug. 1987 Prepared in cooperation with Chicago Univ., Ill.
(Contract W-7405-eng-48)
(DE88-003829; UCRL-97745; CONF-8708165-5) Avail: NTIS HC A03/MF A01

The importance of galactic chemical evolution and the different nucleosynthetic origins for thorium and neodymium are emphasized with regard to the recent observations of neighboring spectral lines from these elements in G-Dwarfs stars and the use of the correlation of the spectral line ratio with stellar age to derive an upper limit to the age of the galaxy. When effects of galactic chemical evolution and nucleosynthetic origin are included the systematic trend in the data toward constant or even increasing Th/Nd ratio with stellar age can be easily understood. A model dependent (3sigma) best upper limit of T sub 0 approx. = 18 Gyr to the age of the galaxy is derived, although simpler schematic models for the evolution of the Th/Nd ratio can give (3sigma) upper limits ranging from 9 to 20 Gyr. DOE

**N88-19398#** Max-Planck-Inst. fuer Chemie, Mainz (West Germany).
**[REPORTS AND CONTRIBUTIONS OF THE MAX-PLANCK INSTITUTE OF CHEMISTRY (OTTO HAHN INSTITUTE)] [MAX-PLANCK-INSTITUT FUER CHEMIE (OTTO-HAHN-INSTITUT)]**
Ulrike Emrich, ed. and Robert Gerwin, ed. 1987 167 p In GERMAN Original contains color illustrations
(Rept-1/87; ISSN-0341-7778; ETN-88-91097) Avail: NTIS HC A08/MF A01

In isotope cosmology and cosmochemistry, presolar nebulae and meteorites, the Earth-Moon system, Earth, and archeometric items were investigated. In geochemistry the chemical composition of the Earth mantle, physics and mineralogy at high pressures, the early development of the Earth mantle and the continental crust, and computer simulation of fluids were studied. Atmospheric chemistry investigations are summarized. In nuclear physics and medium-energy physics the polarizability of protons, the testing of exact theories using the deuteron, the unexplained polarization of X-ray bremsstrahlung, and a gamma-ray monochromator were investigated. ESA

**N88-19399#** Tuebingen Univ. (West Germany). Fakultaet fuer Physik.
**INVESTIGATION OF NUCLEI OF ACTIVE GALAXIES AS WELL AS SOURCES IN THE LARGE MAGELLANIC CLOUD USING THE X-RAY ASTRONOMY SATELLITE EXOSAT Ph.D. Thesis [UNTERSUCHUNG VON KERNEN AKTIVER GALAXIEN SOWIE VON QUELLEN IN DER GROSSEN MAGELLANSCHEN WOLKE MIT DEM ROENTGENASTRONOMIE-SATELLITEN EXOSAT]**
Hermann Brunner 1987 149 p In GERMAN
(ETN-88-91494) Avail: NTIS HC A07/MF A01

Data from galactic nuclei and Magellanic clouds, observed by the EXOSAT satellite, were analyzed. The BL Lac sources 3C 371, MCN 501 and LMC are described. Statistical investigation of the 3C 371 X-ray spectrum show a sharp low energy spectral component; the spectrum above 1keV can be described by an exponential law; a flux variability is found. The MKM 501 source shows a uniform exponential spectrum and a significant variability. The energy spectrum of the X-ray pulsar LMC X-Y was determined. ESA

# 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**N88-19400*#** Atmospheric and Environmental Research, Inc., Cambridge, Mass.
**A MODELING ANALYSIS PROGRAM FOR THE JPL TABLE MOUNTAIN Io SODIUM CLOUD DATA Final Report, 1 Jun. 1984 - 30 Nov. 1987**
William H. Smyth and Bruce A. Goldberg (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) Mar. 1988 337 p
(Contract NASw-3949)
(NASA-CR-182555; NAS 1.26:182555) Avail: NTIS HC A15/MF A01 CSCL 03B

Research in the third and final year of this project is divided into three main areas: (1) completion of data processing and calibration for 34 of the 1981 Region B/C images, selected from the massive JPL sodium cloud data set; (2) identification and examination of the basic features and observed changes in the morphological characteristics of the sodium cloud images; and (3) successful physical interpretation of these basic features and observed changes using the highly developed numerical sodium cloud model at AER. The modeling analysis has led to a number of definite conclusions regarding the local structure of Io's atmosphere, the gas escape mechanism at Io, and the presence of an east-west electric field and a System III longitudinal asymmetry in the plasma torus. Large scale stability, as well as

some smaller scale time variability for both the sodium cloud and the structure of the plasma torus over a several year time period are also discussed. Author

**N88-19401*#** National Aeronautics and Space Administration, Washington, D.C.
**ANALYSIS OF IMPACT CRATER ARRANGEMENT ON THE VENUTIAN SURFACE (FROM PHOTOGRAPHIC MATERIALS OF THE VENERA-15 AND -16 SPACECRAFT)**
V. P. Kryuchkov Mar. 1988 17 p Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya (Moscow, USSR), no. 6, 1987 p 75-83 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20211; NAS 1.77:20211) Avail: NTIS HC A03/MF A01 CSCL 03B

For the first time the population of impact structures on the entire surface of Venus photographed by the Venera-15 and Venera-16 space vehicles is discussed. Distribution of impact craters by classes and as a whole is presented. It is found that the average age of the craters observed is approximately one billion years. Author

# 92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

**N88-19402#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**SOLAR RADIOIMAGE RESTORATION M.S. Thesis, Jun. 1986 [RESTAURACAO DE RADIOIMAGENS SOLARES]**
Edson Alves Ribeiro Aug. 1987 190 p In PORTUGUESE; ENGLISH summary
(INPE-4312-TDL/279) Avail: NTIS HC A09/MF A01

The general problem of image restoration is proposed, as well as a brief description of the methods to solve it. Then, this problem is placed in the context of radioastronomy images by considering the physical aspects of image formation. By using regression techniques for image restoration, computational results are presented. The ill-conditioning of this method due to the presence of additive noise in the image and computer round-off error is analyzed; the analysis of the condition number is also used as a tool to illustrate the ill-conditioning problem. Alternative methods are presented, such as inverse filtering, Fourier domain solution, etc., as well as their computational limitations. Restoration results through the use of regression techniques and the solution for the problem of oscillations due to ill-conditioning are discussed. Simulation results are presented where there exists control over the degradation process, and the proposed method is applied to real radioastronomy images. The problems of lack of knowledge of the degradation process and the computational effort for its solution by using regularization techniques are also indicated.
Author

# 93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

**N88-19403** Princeton Univ., N. J.
**A SKY TEMPERATURE SURVEY AT 19.2 GHz USING A BALLOON BORNE DICKE RADIOMETER FOR ANISOTROPY TESTS OF THE COSMIC MICROWAVE BACKGROUND Ph.D. Thesis**
David A. Cottingham 1987 62 p
Avail: Univ. Microfilms Order No. DA8724800

A large area sky survey at a resolution of 3 degrees carried out with a balloon-borne Dicke radiometer using a liquid helium cooled ruby maser amplifier is described. The instrument and method of observation are described. The data from one flight of the instrument are analyzed to produce a map of sky temperature covering roughly declination -15 to +75 degrees and right ascension 7 to 23 h at a typical sensitivity of 1.5 mK per 3 degrees resolution element. The calibration of this map in terms of antenna temperature is accurate to 3 percent. Analysis of the sky map indicates that the components of the dipole anisotropy of the cosmic microwave background (CMB) are (in thermodynamic temperature) Tau sub x = -3.46 + or - 0.09 mK, Tau sub y = 0.41 + or - 0.07 mK, Tau sub z = -0.50 + or - 0.08 mK, implying that the magnitude is Tau = 3.52 + or - 0.08 mK and has its bright pole at alpha = 11 h 33 m + or - 6 m, delta + -8.2 deg + or - 1.5 deg (statistical errors). These data place an upper bound of delta T/T less than .0002 (95 percent confidence level) on anisotropy of the CMB other than the dipole at all angular scales greater than 3 degrees. Dissert. Abstr.

**N88-19404#** Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
**THERMAL RADIATION FROM NEUTRON STARS [THERMISCHE STRAHLUNG VON NEUTRONENSTERNEN]**
Michael Ernst Schaaf Jul. 1987 258 p In GERMAN
(MPE-203; ISSN-0178-0719; ETN-88-91373) Copyright Avail: NTIS HC A12/MF A01

The magnetic field dependent and hence two-dimensional energy transport through the crust of a neutron star was investigated. The self consistent temperature and density profile in the star crust were calculated by interatively solving a coupled system of two nonlinear differential equations. The profiles show that magnetized neutron stars cool worse and hence slower than unmagnetized. The magnetic field acts as a thermal insulator; it also modifies the thermal radiation from the star surface in a characteristic way. ESA

**N88-19405#** Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
**THE 35-DAY CYCLE OF HERCULES X-1 [DER 35-TAGE-ZYKLUS VON HERCULES X-1]**
Peter Kahabka Aug. 1987 140 p In GERMAN
(MPE-204; ISSN-0178-0719; ETN-88-91374) Copyright Avail: NTIS HC A07/MF A01

The 35-day cycle of the compact X-ray emitting star Her X-1 was investigated using EXOSAT observations. The pulse form of Her X-1 in the energy range between 1 and 30 keV was determined with high statistical significance, and the change of the pulse profile during the cycle was described. The observations of the free precession (nutation) of Her X-1 within a half precession cycle allowed to determine the precession geometry for the neutron star. The evaluation of observations in the soft spectrum of Her X-1 provided clarifications concerning the extended reprocessing regions at the magnetopause of the neutron star. ESA

# 99 GENERAL

No abstracts in this category.

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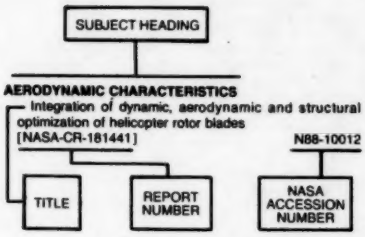


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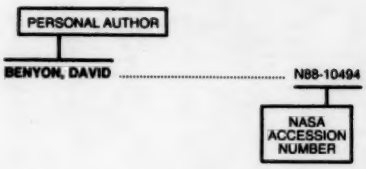


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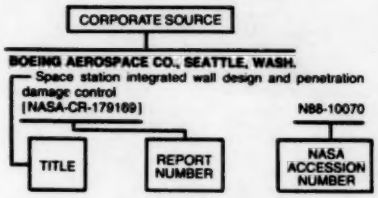


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**HEWLETT-PACKARD CO., SAN JOSE, CALIF.**
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**ILLINOIS DEPT. OF ENERGY AND NATURAL RESOURCES, SPRINGFIELD.**
Alternative Energy in the Midwest: Research and Applications. Conference Proceedings, Rosemont, Illinois, March 19-20, 1987
[PB88-142278] N88-19015

**ILLINOIS INST. OF TECH., CHICAGO.**
UHV (Ultra-High Vacuum) double crystal monochromator design
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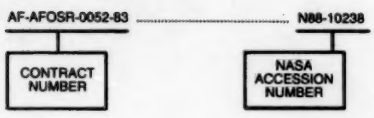


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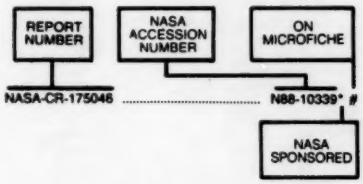


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